POWER SEPTEMBER 1960 TRANSMISSION DESIGN MACHINE DRIVES & COMPONENTS

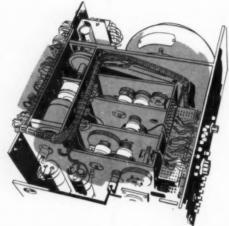




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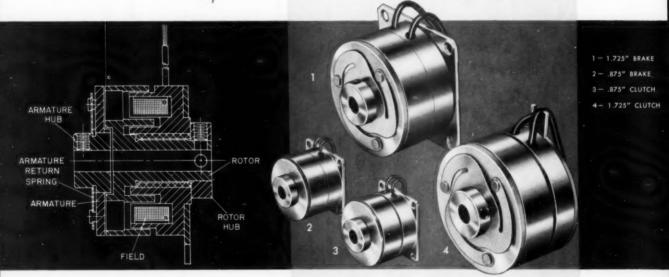
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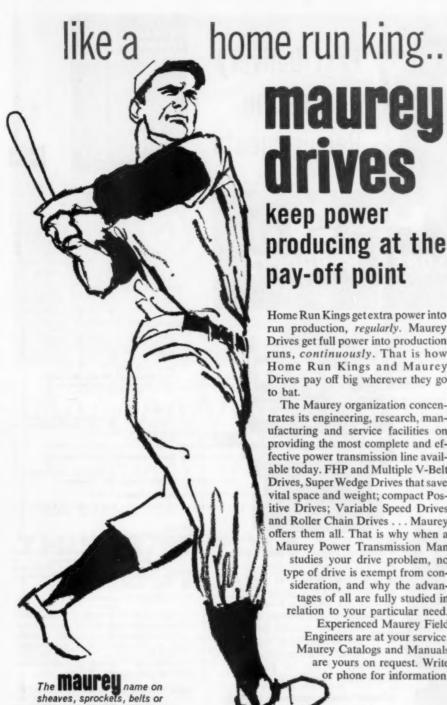


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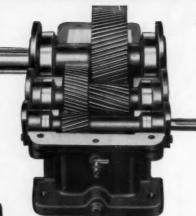


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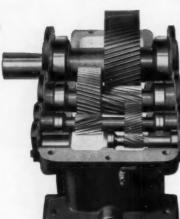


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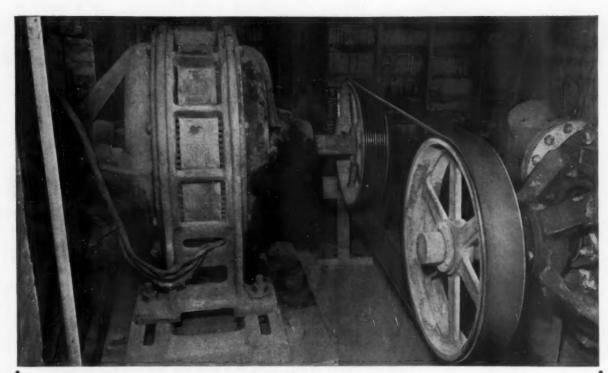
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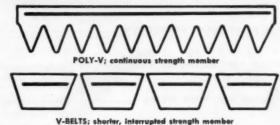
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"MORE USE PER DOLLAR"

Poly-V Beit is a single unit with even, uniform pull. Uninterrupted strength member gives much higher hp capacity per inch of drive width. No beit drive delivers as much power in the same space as Poly-V!

THIS R/M POLY-V' DRIVE OUTLASTED V-BELTS 8-1!

V-belts were replaced every six months on this gas pump drive in a southern chemical plant—until the company converted to R/M's patented Poly-V Drive. The single Poly-V Belt pictured above has been in operation for over 4 years on a barium process operation. Four years for the R/M Poly-V Drive versus 6 months for an ordinary V-belt drive! The savings and advantages to production are obvious.

R/M Poly-V Drive solves difficult drive problems wherever heavy duty power transmission is required. Single unit design permits narrower Poly-V sheaves to deliver equal power in a much smaller space or much more power in the same space as a V-belt drive! The drive runs smoother because there's no sinking of belt in sheave grooves. Belt speed ratios remain constant from no load to full load for uniform power delivery—with less wear on belts and sheaves. V-belt "length matching" problems are completely eliminated . . . and just two belt cross sections meet every heavy duty requirement. Let an R/M representative show you other advantages of converting to R/M Poly-V Drive. Write for Bulletin M141.

When You Change Drives, Convert to Poly-V and Be Sure!

RAYBESTOS-MANHATTAN, INC.

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- More Power—Less Space
- Eliminates "Matching" Problems
- Maintains Groove Shape
- Assures Constant
 Speed Ratios
- Longer Belt and Sheave Life
- Cooler, Smoother Running



ENGINEERED
RUBBER
PRODUCTS
.. MORE USE
PER DOLLAR

SEPTEMBER 1960

volume 2 number 9

FEATURES

POWER TRANSMISSION DESIGN

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ROTARY SHAFT SEALS

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For highly compact, plus-power drives. First major design change in Multiple V-Belts in the last 30 years.



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Pre-stretched link belting available in regular, oil-resistant and staticconductive types.



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Power-balanced construction for flexibility durability and strength.



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Steel cable permits no-stretch installation. All belts are fluoroscoped to assure extra high quality.



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High tensile strength, low stretch belting features high fastener tear-out resistance.



DOUBLE V-BELTS

Relieved cross section assures maximum flex resistance. New control methods provide uniform cord section.

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Used on drives where endless V-Belts are not practical. High fastener tear-out resistance.

RED SHIELD MULTIPLE V-BELTS

Red Shield Belts now offer 40 per cent extra capacity. Iso Dynamic matching and cord stability assure precise balance and long belt life. Also available in oil and heat resistant and static dissipating constructions.



VARIABLE SPEED BELTS



Abrasion resistant cover assures maximum life. Crowned cross section maintains stability under extreme loads.

Test . . . Compare . . . You'll Select

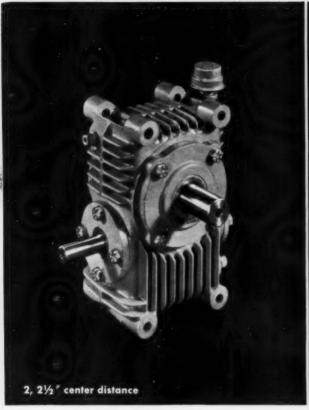
TWOOD V-BELTS

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Look for the DA on your V-Belts

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Custom-build Your Worm Gear Drive from . . .

OVER 200,000 STOCK

The four "worm-under" speed reducers shown above represent only eleven sizes of standard, Cone-Drive units. Also standard are 15", 18", 22", and 24" center distance units. Cone-Drive worm gear reducers are available in ratios from 5:1 to 4900:1 and up to over 1200 HP capacity. All units feature the double-enveloping principle in which the worm and gear wrap around each other for greatest tooth contact, strength, smoothness, shockresistance and quietness of operation.

All Cone-Drive worm-gear reducers feature heavy, ribbed, nickel-iron castings for maximum strength and heat dissipation. Heavy-duty taper roller bearings provide anti-friction support to both worm and gear shafts. Chrome-molybdenum-nickel steel worms and tin bronze gears provide long life

and high strength. The Cone-Drive design also gives the exclusive benefit that, in service, both gear and worm tend to regenerate their true form ... worm and gear wear "in" rather than "out."

Standard Options

By selecting various options, standard units can be obtained to fit almost any drive requirements. By taking advantage of these options in the early design stages, you can often simplify design and improve performance, too. Including size and ratio ranges and options available, Cone-Drive Gears offers over 200,000 worm-gear speed reducer combinations that are standard, shelf-hardware items. Special sizes and ratios can be furnished on a quotation basis. Write for Bulletin CD-218 for complete details.

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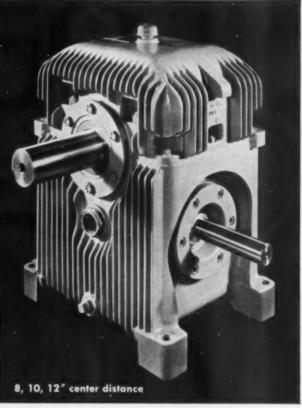




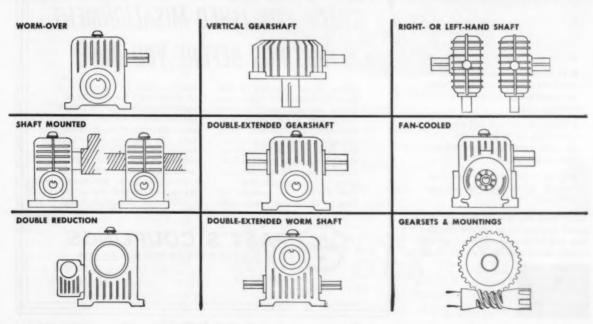








CONE-DRIVE REDUCERS





- Variable speed pulleys with exclusive cam and cam follower feature that assures constant speed regardless of load variations. Ratios to 2.6 to 1. Fractional to 5 hp.
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- Hi-Ratio variable speed pulleys for economy and exceptional efficiency at speed ratios as high as 7 to 1.
- Dual ratio compound drives to provide a compact unit for obtaining speed ranges not possible with a single pulley.
- Motor bases in a full range of types and sizes: adjustable, tilting and movable countershaft.
 Also motor frames.
- Wide V-belt sheaves and wide variable speed belts, sizes from .087 to 14.

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Circle No. 60 on Reader Service Card

NEWS from the power transmission field

Analyser will copy space flight conditions

NEW YORK, N. Y.—A dynamic analyser that will simulate flight conditions from sea level to orbital altitudes is to be installed at Wright-Patterson A.F.B., Dayton, Ohio. Purpose of the analyser is to study how equipment is affected by buffeting, vibration, pitch, roll and yaw in aerospace vehicles.

The capsule that will contain the test specimens is being designed and made by Cook Electric Co. Control systems and the accoustically-shielded mobile target cart will come from Minneapolis Honeywell Regulator Co. Universal Match Co. will provide the hydraulic roll, yaw and pitch mechanism.

Because of very high vacuum problems, test samples will be cleaned and sterilized, then moved from the sterilizing room to the analyser through a moveable plastic tunnel. This and other facilities will be designed and built by Burns and Roe, Inc.

New steel conveyor pulley standard issued

CHICAGO, ILL.—The Multiple V-Belt Drive & Mechanical Power Transmission Association has published a new standard entitled "Welded Steel Conveyor Pulleys—Recommended Load Ratings for Standard Pulleys." The 15-page booklet includes a list of the pulley diameters and face widths which are standard for the industry and tabulated load ratings for steel conveyor pulleys.

New standard is the work of the Steel Pulley Engineering Sub-committee of MVBD & MPTA which was formed in 1958 to formulate a recommended standard of pulley load ratings. It is based on a study made of all available information on

Don't take chances on couplings



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Since misalignment is the basic problem that shaft couplings are designed to solve you'll find a published conservative misalignment rating (along with load capacity rating) for every Fast's Coupling. Compare it with the misalignment rating of any other coupling you are considering. One further advantage of

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ment ratings: You save money on installation because, knowing the ratings, you don't have to line up driving and driven elements with pinpoint accuracy. It's one more important reason why Fast's Couplings are the choice of more equipment manufacturers than any other gear-type coupling. KOPPERS COMPANY, INC., 909 Scott Street, Baltimore 3, Md.



FAST'S COUPLINGS

Engineered Products Sold with Service

pulley design, made by pulley and conveyor engineers working with stress analysts. Their study included theoretical stress analyses as well as data from actual tests using modern strain gage techniques, for all parts of the pulley and shaft assembly. Copies may be obtained from any welded steel conveyor pulley manufacturer or \$1 from MVBD & MPTA. 27 East Monroe St., Chicago 3, Ill.

Dodge forms Swiss, Mexican subsidiaries

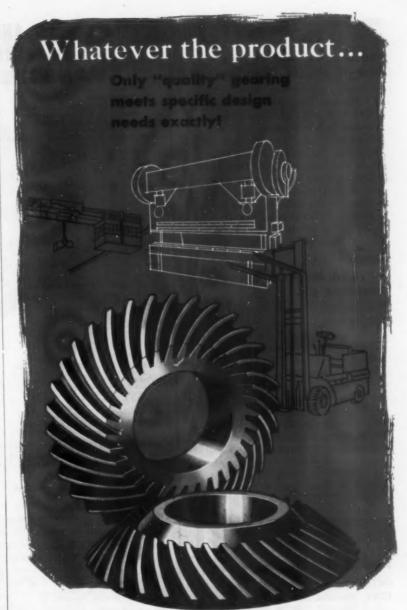
MISHAWAKA, IND.—Dodge Mfg. Corp. has formed a wholly-owned subsidiary, Dodge Manufacturing International A. G. with headquarters in Zug, Switzerland. Arthur Terry III has been appointed European manager of the Swiss company by Dodge president J. Allen Maclean. Purpose of the subsidiary is to acquire and render technical and management assistance to Dodge licensees. At the same time Maclean announced acquisition by Dodge International of majority interest in a new operating subsidiary, Dodge de Mexico, S. A. based in Mexico City. Executive vice president of the Mexican company is former manufacturers' representative Thomas M. Nevin.

Fluid Power Society selects officers

MILWAUKEE, WIS .- The Board of Directors of the Fluid Power Society will consist of: President-Frank L. Mackin, chairman of engineering shops, General Motors Institute; Vice President-Walter Ernst, vice president and director of engineering, Commonwealth Engineering Co.; Treasurer-Allen E. Morris, editor, Hydraulics & Pneumatics magazine; Executive Vice President and Secretary-Barret Rogers. In addition to these officers the board will include: George Altland, supervisor, Hydraulics School, Vickers Inc.; Lynn L. Charlson, president, Char-Lynn Co.

The Fluid Power Society is a new technical organization serving the hydraulic and pneumatic power transmission fields. Charters for local chapters of the Society have been granted to groups petitioning from Detroit and Milwaukee. For information, write Barrett Rogers, 5595 North Hollywood Ave, Milwaukee 17,

Wis.



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GEARS, good gears only

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Foote Bros. and English firm to sell in Canada

CHICAGO, ILL.-Foote Bros. Gear and Machine Corp. and The David Brown Corp., Ltd., London have established a jointly-owned sales subsidiary in Canada. The new firm, to be known as David Brown-Foote Gears. Ltd., will take over sales and distribution, in Canada of gear products made by both companies, plus products of the Whitney Chain Co., a division of Foote Bros. The firm's headquarters will be at 26 Howden Rd., Scarborough, Toronto.

MPTEDA launches group insurance plan

WASHINGTON, D. C.-Members of the recently-organized Mechanical Power Transmission Equipment Distributors Association can now insure themselves and their employees under a group life insurance program. Premiums are \$0.60 per thousand dollars of insurance per month per person for groups of over 25 or \$0.75 for smaller groups. Coverage includes double indemity for accidental death. Rates may be reduced as more companies join. For further details write: MPTEDA, 1028 Connecticut Ave., N. W. Washington 6, D. C.

MEETINGS

OCTORER

American Society of Mechanical 17-19 Engineers-American Society of Lubrication Engineers, Lubrication Conference, Statler Hilton Hotel, Boston, Mass.

30.

- Nov. 1 National Lubricating Grease Institute, Annual Meeting, Edgewater Beach Hotel, Chicago, Ill.
- Society of Automotive Engineers, National Fuels and Lubricants Meeting, The Mayo, Tulsa, Okla.

27-

Dec. 2 American Society of Mechanical Engineers, Annual Meeting, Statler-Hilton Hotel, New York.

JANUARY 1961

9-13 Society of Automotive Engineers, Annual Meeting, Cobo Hall and Convention Arena, Detroit

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CHICAGO—Dodge-Chicago Industrial Equipment Co., 330 E. 24th St. Patlyn Gears and Transmissions Corp., 2456 W. 38th St. Samuel Harris and Co., 114 N. Clinton St.

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McKean Sts. Transmission Equipment Co., 1200 Muriel St.

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WASHINGTON

SEATTLE—Cragin and Co., 932 First Ave., S.

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MILWAUKEE—Badger Bearing Co., 1125 N. Van Buren St. Wisconsin Bearing Co., 1310 S. 43rd St.

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TORONTO-Winnett Boyd, Ltd., 745 Mt. Pleasant Rd.

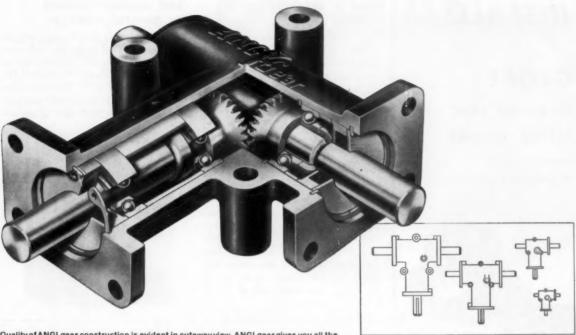


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AIRBORNE ACCESSORIES CORPORATION

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There is only <u>one</u> ANGLgear... and it is made <u>only</u> by Airborne



Quality of ANGL gear construction is evident in cutaway view. ANGL gear gives you all the features of other drives, plus greater hp range (1/3 to 5); permanent lubrication; and Coniflex*design gears for more even load distribution, reduced wear, quieter operation.

ANGLgear is available from local distributor stocks in 4 sizes, 16 models, with various gearing and shaft options.

ANGLgear – introduced in 1951– is the *original* standardized right-angle drive. It is also the No. 1 product in its field – in sales, availability, quality, performance. Witness the thousands of satisfied customers who have bought ANGLgear to date – for applications ranging from simple manual control of valves to classified installations aboard nuclear submarines.

In design and construction, ANGLgear has been refined to the point of being virtually foolproof, provided it is not grossly overloaded. Take a unit off the shelf, install it, run it—for years.

*Trademark of the Gleason Works

And attention is seldom required.

Besides being maintenancefree, ANGLgear is also easy to design into your power transmission systems because of its universal mounting feature. And it invariably costs less than other types of drives. ANGLgear is distributed nationally and is available immediately from local distributor stocks in the models listed here. Special sizes, special gear ratios, etc., can also be furnished. For complete engineering data, contact our local distributor, or write direct for new Catalog IA-58. ANGLgear design template kits are available on request.

BASIC MODEL DATA

Model	Туря	Gear Ratio	нР	RPM Butput Sheft	Oltimate Static Torque ib. in. Output Shaft	Sheft Bin.	WL, D.
R-300	2-way	1:1	1/3	1800	250	3/8	.5
R-300-2	2-way	2:1	1/5	1800	250	3/8	.5
R-310	3-way	1:1	1/3	1800	250	3/8	.5
R-310-2	3-way	2:1	1/5	1800	250	3/8	.5
R-320	2-way	1:1	1	1800	1000	5/8	2.2
R-320-2	2-way	2:1	3/5	1800	1000	5/8	2.2
R-330	3-way	1:1	1	1800	1000	5/8	2.4
R-330-2	3-way	2:1	3/5	1800	1000	5/8	2.4
R-333	2-way	1:1	2-1/4	1200	1500	3/4	8.7
R-333-2	2-way	2:1.	2-1/4	1200	1500	3/4	8.7
R-335	3-way	1:1	2-1/4	1200	1500	3/4	9.0
R-335-2	3-way	2:1	2-1/4	1200	1500	3/4	9.0
R-340	2-way	1:1	5	1200	2500	1	14.5
R-340-2	2-way	2:1	5	1200	2500	1	14.5
R-350	3-way	1:1	5	1200	2500	1	15
R-350-2	3-way	2:1	5	1200	2500	1	15



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MEN of the power transmission field

Brien is president of Ohio Gear

CLEVELAND, OHIO-DOUGLAS D. BRIen has been named president of the Ohio Gear Co., succeeding Harrison Browning who has been appointed chairman of the board after 33 years as president. The 49-year old Brien has been with Ohio Gear for 14 vears, serving as executive vice president since 1949.

Fort Worth makes Rodgers San Francisco manager

FORT WORTH, TEXAS-Estin L. Rodgers has been promoted to San Francisco district manager of Fort Worth Steel & Machinery Co. Previously Denver district office manager, Rodgers will now direct the company's San Francisco operations from the city office and warehouse at Corey Way.

SAE chooses Gilbert as general manager

NEW YORK, N. Y .- Joseph Gilbert has been named secretary and general manager of the 24,000-member Society of Automotive Engineers. He succeeds John A. C. Warner, who has held the post since 1930 and will continue on the SAE staff as an ad-



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visory consultant. Gilbert, SAE's assistant general manager since 1957, has had experience in every phase of the Society's work since joining the headquarters staff 14 years ago, including a period as managing editor of the SAE Journal.

Butscher joins T. B. Wood's Sons

CHAMBERSBURG, PA.—Harold A. Butscher has been added to the Chicago sales team of T. B. Wood's Sons Co. He will make his headquarters



BUTSCHER

at Wood's regional office and warehouse in Chicago. Butscher, who holds a B.S.M.E. degree from Illinois Institute of Technology, was formerly Chicago district engineer in power transmission sales for the U. S. Rubber Co.

Bernstein Bros. promotes Derrow vice president

PATTERSON, N. J.—David D. Derrow has been promoted to vice president of Bernstein Bros, Inc. His new executive duties will be in addition to his present job as sales manager of the corporation.

Roehm appointed Barden vice president

DANBURY, CONN.—Perry R. Roehm has been made vice president of The Barden Corp. He will assist the president in general management of the company. Roehm was formerly vice president of sales at Barden, leaving in 1955 to become vice president and later president of Norden-Ketay Corp. His last post was president and director of Intelex Systems, Inc.



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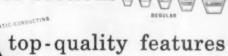
deeper than regular types,

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ANOTHER FAWICK USER REPORTS:

We specify Fawick Magnetics because they are among the very best on the market! **

So states Jim Tankard, Director of Machine Design at Zagar Incorporated, Cleveland machine tool manufacturer who uses FAWICK Magnetic Clutches on their new multiplespindle nut tapping machines that can outproduce all other known methods.

These machines can tap up to 100,000 nuts per hour as compared with the 4,000-unit average of single-tap machines. Split second cycling of heavy torque loads with smooth, instantaneous starting and stopping of the spindle head are essential. The FAWICK units were chosen for the job in accordance with Zagar's stated policy of "... using only the finest components available".

Two SC Magnetic Clutches, one forward and one reverse, transmit torque from a motor-driven flywheel to the main drive crank of the gearless spindle head. Motor and flywheel run continuously and need for motor reversal is eliminated. As the tapping operation is completed, the forward clutch disengages and the SA Magnetic Brake stops the spindle head. The reverse clutch engages and taps are withdrawn from the work. Each cycle includes full engagement and disengagement of all three Magnetic units, working at tremendous torques, plus indexing of the work-holding plate . . . all in less than five seconds!

Imaginative designers like Zagar are putting FAWICK Magnetics to work in hundreds of ways, but with a single purpose: to get the best in electric clutch and brake performance. For complete information contact your nearest FAWICK representative, or write the Home Office, Cleveland, Ohio.

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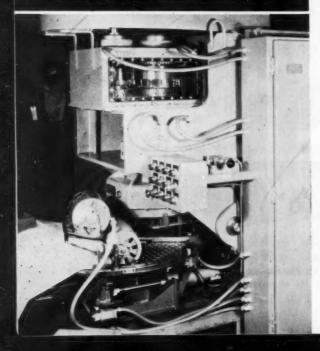
INDUSTRIAL CLUTCHES AND BRAKES

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with two Fawick Magnetic Clutches and one Magnetic Brake for full torque transmission at high cyclic rates. Machine has highest tapping capacity of all nut tapping machinery.

(Below) Fawick SC Magnetic Clutches control forward and reverse motion of spindle head, provide smooth action with shock-free engagement, work in visible oil splash environment.



What's available in...

POWER TRANSMISSION

DESIGN SEPTEMBER 1960



- Labyrinths
- Rings
- Radial lip seals
- Mechanical seals
- Felt washers

ROTATING shaft seals perform two very important functions in power transmission systems. They seal lubricant in and dust and dirt out. There are many different types intended for use with various lubricants under different conditions. All of those various types may be divided into two categories: (1) Clearance Seals, and (2) Contact Seals.

Clearance seals limit leakage between a rotating shaft and housing by maintaining a small, closely controlled annular clearance between shaft and housing. Contact seals, on the other hand, have zero clearance, and there is actual contact and rubbing between the stationary and rotating parts.

Clearance Seals

Because there is no rubbing with clearance seals, they offer many advantages. They do not wear, create heat due to friction, or consume power. They will work over extremely wide temperature and speed ranges. However, these advantages result from the same thing that's responsible for their big drawback—they always have some leakage.

If some leakage can be tolerated, clearance seals are a very good choice. With grease, in particular, a clearance seal may often give so close to zero leak-

age that it's an excellent choice.

There are two basic types of clearance seals: bushings and labyrinths. The bushing seal is simply a close-fitting stationary sleeve. Leakage from the high-pressure end to the low-pressure end is limited by the throttling action of the limited clearance. Because of eccentricity of the shaft and its bearings and the possibility of differential thermal expansion, the clearance between a stationary bushing and rotating shaft must be larger than would be needed otherwise.

By using a floating bushing, Fig. 1, clearance between the shaft and bushing can be materially reduced to make the use of a bushing seal practical where it would otherwise have too high a leakage rate. In floating bushings, eccentric motion of the shaft is transmitted through the medium being sealed to displace the bushing radially and keep the shaft and bushing nearly concentric.

With a long bushing like that shown in Fig. 1, misalignment of shaft and housing may unseat the bushing at the sealing dam. This disadvantage is eliminated of labyrinth—increased length and complex assembly procedures.

Clearance seals are sometimes used in combination with a rubbing seal to get zero leakage and reduce the load on the rubbing seal.

Sizes, speeds, availability: There is practically no limit to the sizes, speeds, and temperature at which clearance seals can operate. For example, they have been successfully used at speeds in excess of 30,000 rpm, to seal pressures as high as 5000 psi, and at temperatures in excess of 1000 F. They have been used with shafts in excess of 10-in. diameter and less than ½-in diameter.

There are few, if any, off-the-shelf clearance seals available. They are custom designed for the application either by the designer of the machine or a company specializing in the manufacture and design of seals.

Contact Seals

By far the majority of seals used in power transmission systems as lubricant seals fall into this group. There are four general types:

- 1. Felt seals
- 2. Radial lip seals
- 3. Mechanical or axial seals
- 4. Ring seals

Each of these has its own particular field of application depending on speeds, temperatures, lubricant to be sealed, and pressure expected. Other service conditions which may affect seal selection are shaft deflec-

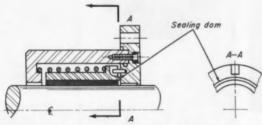


FIGURE 1. Floating bushing seal limits clearance between shaft and stationary parts to seal. Because it floats, it will accommodate eccentricity and runout, but length limits allowable misalignment of shaft and housing bore.

by using an extremely short bushing or ring. To obtain the necessary length for throttling, a number of rings are usually used, Fig. 2.

Probably the most common type of clearance seal is the labyrinth, Fig. 3. It has one or more lands on either the shaft or the housing. Usually, at least three lands are used. Labyrinth seals are also made with the lands concentric with the shaft, Fig. 4. This construction eliminates two of the objections to the other type

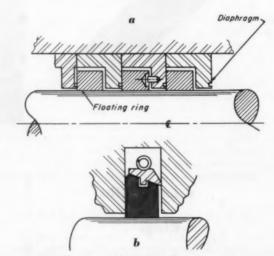


FIGURE 2. Short bushings or rings used as a clearance scal allow some misalignment of shaft and housing with little loss of scal efficiency. Length of the scal is increased by using multiple rings. The ring shown at b is called a Huhn ring. It is made up for segments held together by a garter spring. Construction gives a tight scal at the gaps and between the sides of the ring and the groove.

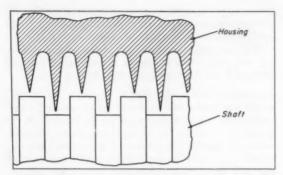


FIGURE 3. Labyrinth type of clearance seal is widely used, particularly with grease. Housing portion must obviously be split for installation.

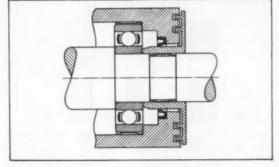


FIGURE 4. Labyrinth seal with lands and grooves concentric with the shaft is shorter than that with lands spaced along the shaft.

tion, runout, endplay, and surface finish. These considerations as related to the different kinds of seals will be discussed.

Felt Seals

Properties recommending felt as a seal material are: high liquid absorption, low coefficient of friction, and high resilience throughout its normal life. It's inexpensive and a natural dust and dirt collector. Felt seals are sometimes used in conjunction with other types for their ability to stop dust and dirt.

Felt seals are generally used with high-viscosity oils and greases at temperatures of -60 to 250 F with rubbing speeds of 2000 fpm or less. Despite the general limitation of 2000 fpm, felt seals are operating at speeds as high as 4000 fpm with hard, smooth shafts with ample lubrication.

There are three forms in which felt seals are available. These are plain washers, laminated seals, and metal cased units. With all three types, it's recommended that the seal be saturated just before installation with an oil or grease of slightly higher viscosity than the lubricant to be sealed. All three may also be had with special impregnation for particular applications. For example, graphite impregnation for low friction, and impregnation with paraffin or petrolatum compounds to prevent leakage of pressurized lubricants or to keep out water or mud.

Plain felt seals, Fig. 5a, are precision-cut from standard SAE grades of felt in standard sizes, Table I. This table also specifies the angle of the housing in which the washer is mounted.

If run dry, the plain felt seal will polish rather than score the shaft. Under normal operating condi-

Table I-Dimensions and Housing Angle for Plain and Laminated Felt Seals

SAE Felt Grades	Shaft Diameter (in.)	Washer ID (in.)	Washer OD (in.)	Washer Thickness (in.)	Housing Angle (deg.)	Application
F-I F-2 F-3	0.5 1.0 1.5 2.0 2.5 3.0 3.5	0.495 0.995 1.495 1.995 2.495 2.495 3.495 3.995	1.00 1.50 2.25 2.75 3.25 4.00 4.50 5.00	0.187 0.250 0.375 0.500 0.500 0.500 0.750	4 4 4 4 4 4	Difficult oil or grease retaining con- ditions and shaft speeds exceeding 1000 feet per minute.
F-5 F-6 F-7	0,5 1.0 1.5 2.0 2.5 3.0 3.5 4.0	0.485 0.985 1.485 1.985 2.485 3.485 3.985	1.00 1.50 2.25 2.75 3.25 4.00 4.50 5.00	0.250 0.375 0.500 0.500 0.500 0.750 0.750	55555555	Oil or grease retaining washers for shaft speeds between 750 and 1000 feet per minute. Also, difficult dust exclud- ing conditions where shaft speeds ex- ceed 1000 feet per minute.
F-10 F-11 F-13 F-15	0.5 1.0 1.5 2.0 2.5 3.0 3.5	0.469 0.969 1.469 1.969 2.469 2.969 3.469 3.969	1.00 1.50 2.25 2.75 3.25 4.00 4.50 5.00	0.375 0.500 0.500 0.500 0.750 0.750 1.000	7 7 7 7 7 7 7	Oil or grease retaining washers to shaft speeds less than 750 feet pe minute. Also, dust excluding washer for shaft speeds less than 1000 feet per minute.
F-50	=			0.050 0.055 0.060 0.065 0.070 0.075 0.080		Precision ball bearing seals.

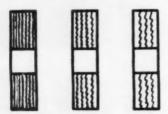


FIGURE 5. Plain felt seals are precision cut washers. They are available in various densities.

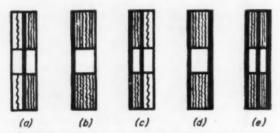


FIGURE 6. Laminated felt seals combine felt washers and impervious layers of an elastomer.

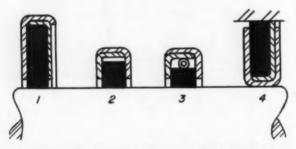


FIGURE 7. Housed felt seals are available in four types. The first is simply a felt washer in a metal case. Second is intended for high runout. Washer rotates with the shaft and seals in the housing. Three has a garter spring to accommodate more runout than Two. Fourth type has internal housing pressed on shaft and felt rubs against ID of the housing.

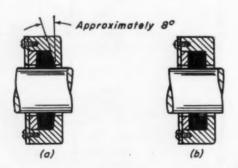


FIGURE 8. Typical installation methods for felt seals. The cupped ring, c, is prepared by soaking a ring whose ID is smaller than the shaft in melted grease and then

tions, plain felt seals have long life and should need replacement only when the machine in which it is used is completely overhauled.

With extremely low viscosity lubricants, a plain felt seal may work if properly impregnated. But, the laminated seal is probably a better choice.

Laminated felt seals, Fig. 6, are made up of felt layers and impervious layers of an oil-resistant elastomer. The elastomer layer or layers function as a positive dam against low-viscosity lubricants. The seal shown in Fig. 6a has a layer of low-density felt on the air (left) side for improved dust and dirt sealing and a layer of high-density felt on oil side of the elastomer to improve lubricant sealing. Other constructions shown are for more difficult sealing applications.

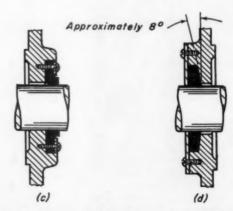
Cased felt seals: Seals of this type are available for pressing into straight bores and also onto shafts where it's desired to seal against a bore rather than the shaft. This is particularly recommended where the shaft is stationary and the bore rotates because centrifugal force would tend to pull the felt away from the shaft.

Two variations in the metal-cased felt seals are available for use where shaft runout is high or with self-aligning bearings, Fig. 7. In both cases the felt is a press fit on the shaft so sealing surfaces are within the metal case. The unit with the garter spring will work under more difficult conditions than the other.

Felt washers used in metal-cased felt seals may be either plain or laminated.

Installation: Some typical ways of installing felt seals are shown in Fig. 8. General installation precautions are:

- Seal must not fit the shaft too tightly and retainer should not compress the felt excessively.
- Height of the felt in the groove should usually be greater than the width to reduce chances of distortion and improve holding.
- 3. Soak the felt in light mineral oil before installing.



shaping and mounting it as shown with a specially prepared mandrel. It is impervious to the finest dust and grit.

- 4. The felt ring should be one piece if possible. If it must be split to simplify installation, cut the joint at a 30 deg angle and be sure to close the joint properly when installing the felt.
- The shaft should be smooth and free of nicks and burrs, particularly where the felt rubs.

Radial Lip Seals

These seals may be used at higher pressures, speeds, and temperatures generally than felt seals. They will also seal less viscous lubricants. Like felt seals, they also seal out dirt. They may sometimes be combined with a felt ring to improve their dirt sealing ability.

There is a real variety of seals of this general type, all with some particular feature to recommend them. They fall into four general categories:

- 1. Bonded seals
- 2. Cased seals
- 3. Composition seals
- 4. Dual-element seals

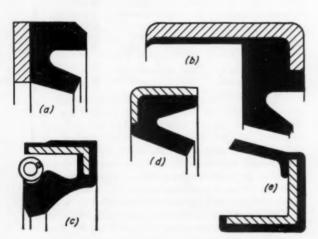
Bonded seals, Fig. 9, use synthetic rubber or other elastomeric material bonded to a metal case or washer. They may or may not use garter springs. Maximum recommended operating speeds range from 1000 to 5000 fpm. Designs for temperatures to 500 F are available. However, 250 F is a more typical maximum operating temperature.

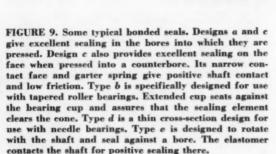
Pressures at which these seals will work, although higher than felt, are usually no higher than 15 psi. There is a definite relationship between the pressure sealing ability and shaft speed, as well as other variables. Table II shows this effect. Some designs are available for sealing at pressures of 100-150 psi. However, sealing at these pressures is usually possible only at speeds of 2000 fpm or less.

Table II—Pressure Rating vs. Shaft Speed

Seal Type	Speed (fpm)	Pressure (psi)
Leather	0-300	0
(no spring)	300-600	0
(600-1000	0
Leather	0-800	15
(spring loaded)	800-1500	10
	1500-2000	5
Synthetic	0-500	10
(no spring)	500-1000	7
	1000-2000	5
Synthetic	0-1000	25
(spring loaded)	1000-2000	10
	2000-3000	5

Note: The values in his table are only intended to show relative pressure scaling ability of these types of seals; they are not recommended maximum values for all cases.





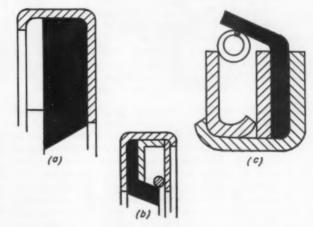


FIGURE 10. Metal cased seals. Leather sealing elements can be had in cased seals. As far as function and design is concerned, the only real difference between these and bonded seals is in the sealing material. Practically all cased designs can be had with either leather or elastomeric sealing element. Design α is an exception; it's available only with a leather washer. It is most often used to seal heavy grease or as an auxiliary seal at speeds below 1000 fpm. Types b and c are conventional designs for internal and external sealing respectively.

ROTATING SHAFT SEALS continued

Cased seals, Fig. 10, use either an elastomeric or leather sealing element. The leather element is superior to the elastomeric element where the seal is not constantly lubricated, since leather is porous and will absorb enough lubricant to operate with no more lubrication than this for fairly long periods. Also, leather does not need quite as smooth a finish on the shaft for satisfactory operation. In fact, leather can work well even when shafts or bores are rusty.

Use of leather sealing element is limited to about 200 F and surface speeds of 2000 fpm. The synthetic rubbers, or elastomers, must be used for higher speeds and temperatures. Elastomers are also resistant to a wider variety of fluids than leather. Another plus for the elastomers is their ability to work with more shaft runout and eccentricity.

About the only important difference between cased and bonded seals with elastomeric sealing elements is that bonded types can be made a little thinner and smaller in OD for the same shaft size. Also, the bonded unit can be designed to have an elastomeric surface on the OD. This can produce a better seal on the OD when the bore into which the seal is pressed is rough or out of round. Coatings or cements applied to the OD of cased seals will improve sealing in bores. One manufacturer will supply seals with this coating.

Composition seals, Fig. 11, are similar in basic design to cased and bonded seals. Necessary rigidity is given the units by making the heel of an asbestoselastomer composition. In some instances, metal reinforcing rings are molded into the heel. Advantages claimed for this type of construction are improved sealing in the bore, and ability to conform to bores that are somewhat out of round. The composition heel is also highly resistant to corrosion. Performance specifications of this type of seal, as far as temperatures, speeds, etc. are concerned, are in the same range as for cased and bonded seals.

Spring loading: Practically all lip seals can be had with or without a spring to improve contact of the sealing member with the shaft. The springs may be either coiled garter springs or bonded multiple leaves, Fig. 12a. In some instances, both types of spring may be used. Using the spring or springs increases allowable operating speed, pressure at which the seal will work, allowable shaft runout, and allowable shaft to bore alignment. Table III compares performance capabilities of spring-loaded and nonloaded elastomeric lip seals.

Dual-element seals are simply two sealing elements combined in a single assembly, Fig. 12. Reason for using dual element seals is to get improved sealing. Some of the specific types and the way in which they improve sealing are: (1) felt washer and lip seal to give improved dust and dirt sealing, (2) opposed elements to seal two liquids from each other, a gas from a liquid, or to improve dust and dirt sealout; (3) tandem elements to improve sealing in depth and reduce leakage to a minimum.

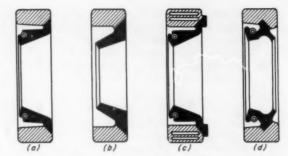


FIGURE 11. COMPOSITION SEALS. Elastomeric elements (solid black) are bonded to composition rings. Applications and types are similar to cased and bonded types. Type c has metal reinforcing rings in the composition ring. Type d is dual element unit. External types are also made.

Table III—Spring-Loaded vs. Springless
Seal Performance

	Springless S	pring-loaded
Shaft speed (fpm)	2000	3000
Temperature (deg F)	-40-300	-40-300
Pressure (psi)	10	15
Shaft finish (rms)*	5-30	5-30
Shaft hardness	Clean: 20	Clean: 20
(Rockwell C)	Abrasive: 30	Abrasive: 30
Shaft diam tolerance		
(± in.)	0.002	0.002
Shaft to bore	0.010†	0.015
Misalignment (in.)	0.005	0.005‡
Shaft runout (in.)	0.015†	0.030+
	0.005‡	0.020‡

*Depends on speed and other conditions.

†At slow speeds

‡At high speed

The opposed seal, Fig. 12b, is constructed in this way because the radial lip seal is basically a single-direction, pressure-energized device. Pressure in one direction forces the seal lip against the shaft to improve sealing, while pressure in the other direction may lift the seal lip off the shaft very easily. This unidirectional sealing property is a result of the shape of the sealing element.

Shaft surfaces: As shown in Table III, there is some variation in shaft hardness and surface finish allowable with radial lip seals. However, they must, in general, be hard and smooth. If the shaft must be of some soft metal such as brass or aluminum, the surface against which the seal bears should be hard chrome plated or a hard steel bushing should be shrunk or pressed on the shaft to provide a wearing surface. In some cases, such bushings are used on hard steel shafts to eliminate refinishing the entire shaft if the seal lip scores or grooves the surface.

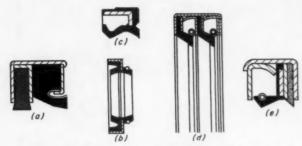


FIGURE 12. DUAL-ELEMENT SEALS. Seal a combines felt and elastomeric elements. Opposed elements, b, c, are used to seal two lubricants from each other or improve dust and dirt sealing. Tandem element, d, may be either leather or elastomeric. It improves sealing in depth. Unit with leather washer and garter spring loaded elastomeric element, e, gives improved dirt exclusion.

In addition to smoothness, nature of the shaft surface is important. Polishing or grinding is best since the finish marks then have no spiral lead. Spiral lead will carry fluid along, like a thread. If there is any lead in the finish marks, they should tend to carry the fluid in rather than out past the seal.

A recently developed type of lip seal, Fig. 14, eliminates shaft finish considerations by incorporating the lip contact surface in the seal assembly.

Sizes: Radial lip seals are available for shafts from \(\frac{1}{4}\)-in. to more than 5-ft diam. Admittedly, there aren't too many standard sizes to choose from if your shaft is over 6-in. diam. Bore sizes are nominally \(\frac{1}{2}\)-in. minimum larger than the shaft size. There is quite a variety of bore sizes to choose from for a particular shaft size as shown by Fig. 13.

Installation: Many a properly selected seal hasn't worked because it was installed carelessly. Assuming that the seal, shaft, and bore are all the right size, the first step is: Be sure that bore and shaft are clean and smooth. Next, be sure the seal lip is lubricated so it won't run dry when the machine first starts. Many leather seals are prelubricated, but its still a good idea to soak them in oil, preferably neat's-foot oil, before installation. Synthetic seals should be dipped but not soaked in oil. If the seal surface to be pressed into the bore is metal, it can be coated with a sealer to eliminate any possibility of leaks around the OD. Gasket cement, shellac, white lead, or red lead can be used.

Now, be sure that any sharp edges which might cut the seal lip, such as keyways and splines are covered by a thin metal sleeve. Seal manufacturers recommend that this sleeve be not more than 1/32-in. larger in diam than the shaft (cellophane tape can be used to cover splines and keyways in a pinch). Use a thimble (cone-like tool) to expand the sealing lip over the end of the shaft if it's a straight shaft. Tapered shafts are preferred. Be sure the seal lip is pointed in the right direction, Fig. 15. Remember, the seal is pres-

Shaft Diameter	Seal O. D. ±.002	Bore Diameter ±.0015	Width ±1/64
	Inc	ches	
21/2	3.005	3.000	1/4
(2.500)	3.194	3.189	1/4
	3.250	3.245	1/4
	3.256	3.251	1/4
	3.355	3.350	1/4
	3.376	3.371	1/4
	3.486	3.481	1/4
	3.505	3.500	1/4
	3.548	3.543	1/4
	3.628	3.623	1/4
	3.756	3.751	1/4
	3.881	3.876	1/4
	4.008	4.003	1/4
211/2	3.250	3.245	1/4
(2.531)	3.256	3.251	1/4
	3.355	3.350	1/4
	3.376	3.371	1000
	3.486	- Suppliers	-

FIGURE 13. Portion of a manufacturer's catalog shows that seals of a given ID are available with a variety of ODs.

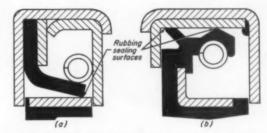


FIGURE 14. Shaft or bore smoothness and hardness are not critical with these internal and external seals. Rubbing surface is part of the seal assembly. External type, b, is dual unit.

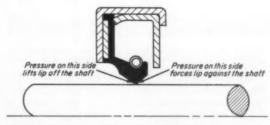
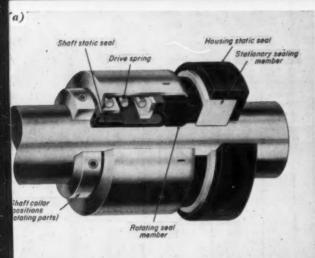
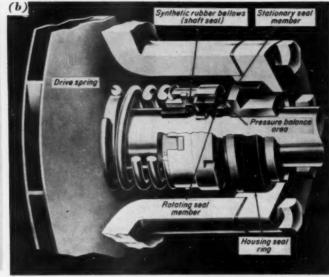
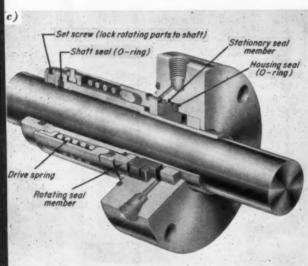


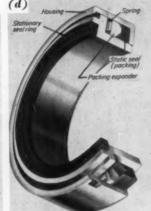
FIGURE 15. When installing a seal, point the lip in the right direction! If it's in backwards, it's sure to leak.

sure energized and easily unseated by pressure in the wrong direction. The lip should point in unless its purpose is to exclude dust and dirt and there's no











interference sealing between the shaft and seal unit and between bore and seal unit eliminates shaft and bore finish problems. Also, these parts (shaft and bore) cannot possibly be worn by the seal. Designs d and e do

FIGURE 16. TYPICAL MECHANICAL SEALS. Positive

ROTATING SHAFT SEALS continued

danger of lubricant leakage. Push the seal onto the

The seal should be pressed into the bore with a pipelike tool just a little smaller than the bore. If there's no press, a mallet and wooden block may be used to tap the seal into the bore. Care must be taken so the seal is at right angles to the shaft, not cocked in the

Mechanical Seals

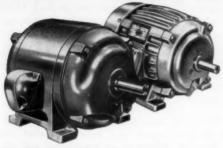
A mechanical seal is a packaged seal assembly containing precision-finishing running seal surfaces. Neither shaft or bore are involved in the sealing not show a rotating seal member because they are designed to work against a shoulder or collar on the rotating shaft. All of these designs incorporate springs which load the seal faces to prevent leakage at zero pressure, take up axial wear of the sealing members, and also keep seal faces in contact despite linear expansion or contraction of the shaft. In designs a, b, and c, the springs also transmit driving torque from the shaft to the rotating seal element.

process. Usually, the sealing members contact on faces at right angles to the shaft axis. Mechanical seals are sometimes called axial seals for this reason. The mechanical seal unit has static seals between its rotating and stationary members and the shaft and bore with which it is used.

Mechanical seals cost more than the previously discussed types. In return, they offer the following ad-

- 1. No wear of shaft or bore, finishes of these parts
- 2. Relative insensitivity to shaft deflection, end play, or runout.
- 3. Operate at higher pressures, and temperatures, and speeds.
- 4. Low leakage rates.

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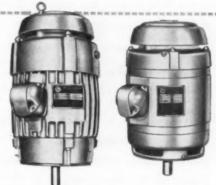
HORIZONTAL MOTORS, Uniclosed, dripproof, ½ to 250 h.p.; Totally Enclosed, 1 to 150 h.p.; Explosion-Proof, 1 to 150 h.p. (Other available types not shown)



INTERNALLY GEARED MOTORS, Syncrogear, ½ to 30 h.p.; Syncrogear Right-Angle worm-gear, ½ to 2 h.p. (Other available types not shown)



VARIABLE SPEED MOTORS, Varidrive, upright, ¼ to 75 h.p.; Varidrive, horizontal, ¼ to 60 h.p. (Other available types not shown)



VERTICAL MOTORS, Unimount vertical solid shaft, ½ to 500 h.p.; Unimount Totally-Enclosed, ½ to 150 h.p.; Unimount Explosion-Proof, ½ to 150 h.p. (Other available types not shown)

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Key to numerical type designations

- 1. Labyrinth seals
- 2. Floating bushings, rings
- 3. Felt washers
- 4. Cased felt washers
- 5. Radial lip seals
- 6. Mechanical seals
- 7. Piston rings
- 8. O-rings and special cross-section elastomeric rings

ROTATING SHAFT SEALS continued

Numerous special designs are available for special applications. Construction materials, for example, vary with speed, temperature, and other conditions. Some typical designs are shown in Fig. 16.

Sizes: Standard mechanical seals can be had in sizes from ½-in. shaft diam to 4-in. diam. Sizes larger than this are also available. They are not, however, off-the-shelf items. Unlike lip seals, there is little choice of bore diam once shaft diam has been decided. There is some variation between seals made by different manufacturers but for a given style, there is not the wide range of bores available that there is in lip seals.

Mechanical seals are generally longer than lip seals. Construction is, of course, responsible for this. However, there is quite a bit of variation in length to diameter ratios of different seal designs, see Fig. 16.

Types: The terms: stationary, rotating, balanced, unbalanced, inside-mounted, and outside-mounted are used to describe differences in mechanical seal designs. Stationary means that most of the parts of the seal do not rotate. This fits these seals well to high-speed applications. Rotating is the opposite, of course. Installation of rotating seals is somewhat simpler than for stationary seals. Also, the rotating seal tends to throw out sludge or sediment by centrifugal action.

Balance and unbalance relate to the effect of the pressure of the fluid being sealed on the contact of the sealing faces. In the unbalanced seal, pressure of the fluid forces the faces together. This type of seal cannot, therefore, be used for very high pressures. Other designs either partially or totally balance the pressure. The majority of mechanical seals are partially balanced.

Inside- and outside-mounted tell whether the majority of the seal parts are inside or outside the housing being sealed. Pros and cons of these two types are: No possible damage to seal parts from the fluid with outside mounting and no space inside the housing required. Inside mounting is nevertheless most popular and usually more compact.

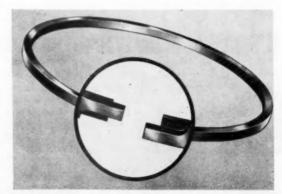


FIGURE 17. Specially-designed ring ends improve sealing by closing the usual ring gap, but still let the ring expand or contract.

Performance: Mechanical seals have worked at pressures as high as 5000 psi, temperatures in the neighborhood of 500 F, and rubbing speeds of 15,000 fpm.

Ring Seals

Certain types of ring seals are actually clearance seals. These have already been discussed. Rubbing types of ring seals which are sometimes used as lubricant seals for rotating shafts are:

- 1. Metallic (piston) rings
- 2. O-rings (elastomeric)

Metallic ring seals are the familiar piston rings used for sealing reciprocating pistons. When used for sealing rotating shafts, the ends are often specially designed to limit or stop leakage at the ring gap, Fig. 17. Ring gap leakage may also be prevented by using multiple rings or concentric rings with staggered gaps.

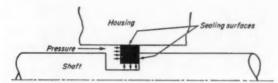


FIGURE 18. Pressure on a piston ring by the fluid being sealed causes the ring to seal on the OD and the face in the ring groove.

The way in which a piston ring seals depends upon the pressure it is sealing in some instances. A ring or rings merely create a labyrinth unless pressure is applied to force the ring into contact with the side of the groove. In some cases they are used in just that way. When they are energized by pressure of the fluid being sealed or by springs, they contact the side of the groove and become rubbing seals, Fig. 18.

Piston rings do not, generally, provide leaktight sealing. They will, however, operate at elevated temperatures; the installation can be designed to work

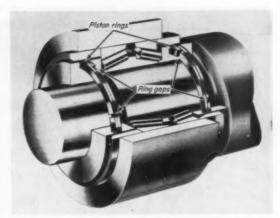


FIGURE 19. Piston ring sealing of a steel mill reduction gear drive. In this application, intense heat, water, and mill scale were present. Dual rings with staggered, straight-cut gaps are used. Replaceable bushings on shaft and in housing are ring contacting members. Rings are stainless steel alloy.

with differential expansion of shaft and bore over a fairly wide temperature range, and the machining needed to incorporate them into a design is relatively simple. However, this machining must be precise.

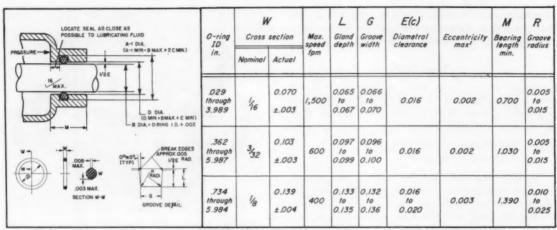
Largest use of piston rings for rotary sealing is in high-temperature applications and applications combining high temperature and gritty dirt, Fig. 19. Where downtime is expensive, they are an attractive sealing means if the small amount of leakage can be tolerated. Sudden failures are extremely unlikely and life may be four to five times that of more commonly used seals. To offset this, they are more costly than some other types.

Piston rings for rotary sealing are available in sizes from 3/8-in. to several ft in diameter. Rings over a foot in diameter are special, but available from several sources. Rings are available in a variety of materials with different surface treatments to fit them to a variety of jobs. Table IV gives a few facts on some successful ring sealing jobs.

Table IV-Piston Ring Seal Performance

Diam. (in.)	No. of rings	Ring mat'l	Ring type	Medium sealed	Press (psi)	Temp (F)	Speed (rpm)	Leakage
0.750	1	Iron	1 pe	SAE 30 oil	30	250	30,000	_
1.000	1	Iron	2 pe	MIL-L-7808	400	500	4,000	.6 cc/min
2.500	1	Bronze	SS*	SAE 40 oil	250	200	2,000	_
3.250	1	Iron	1 pe	SAE 30 oil	2-600	250	2,500	.3 lb/mir
5.750	1	Iron	1 pe	SAE 40 oil	325	250	2,000	.4 lb/mir
6.000	1	Iron	1 pe	SAE 40 oil	400	350	2,000	.5 lb/min
6.750	1	K-30	2 pe	SAE 40 oil	300	250	1,400	_
10.375	1	Iron	SS*	SAE 40 oil	0-5	300	2,500	0+
30.000	2	Iron	SS*	Grease	0+	100	1,500	0+
44.000	1	K-30	2 pc	SAE 40 oil	150	200	1,750	_

^{*}Step seal ring



'Total indicator reading between groove OD, shaft and adjacent bearing surface.

FIGURE 21. Recommended shaft and housing dimension for rotary O-ring seal glands.

ROTATING SHAFT SEALS continued

O-rings and other special cross-section elastomeric sealing rings ordinarily used for static and reciprocating seals can also be used for sealing rotating shafts. They have operated successfully at speeds to 1500 fpm. However, they are not generally recommended for speeds above 900 fpm.

The O-ring compounds used for rotary seals are generally harder than those used in other applications. Durometer hardness of rings recommended for this service ranges from 80-90. Compounds containing graphite are often used. Manufacturers caution that these compounds may not work well with all metals because of the graphite. Particular mention is made of the possibility of pitting of stainless steels.

O-rings used for rotary sealing are installed in a groove in the bore or housing, not in a groove in the shaft if the shaft is the rotating member. They may also be used in a stamped sheet metal housing pressed into a bore, Fig. 20. Tolerances must be closely held on this type of seal. Eccentricity or shaft runout should be no more than 0.0005 in.

Recommended operating temperature range is -40-250. Temperatures lower than this cause the ring to lose resilience so it will not seal well. Contraction is also a problem at these low temperatures.

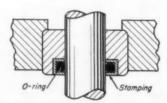


FIGURE 20. Machining a groove for an O-ring shaft seal is not necessary if the O-ring is installed in a stamped sheet-metal housing. This design has been used as an oil seal on drill press spindles.

To prevent excessive heating of the O-ring, the gland or housing should not be used as a bearing surface and total diametral clearance of 0.016 in. should be provided to be sure the shaft does not rub the O-ring housing. Shafts should be hardened to approximately 55 Rockwell to prevent excessive wear in high-speed applications. Recommended groove dimensions and other data on rotary O-ring seals are shown in Fig. 21.

Acknowledgement

Co-operation of the following companies in providing information for use in this article and the noted illustrations and tables is acknowledged with thanks.

American Felt Co Figs. 5, 6, 8, Tal	ole I
Borg-Warner Mechanical Seals, Div.	
Borg-Warner CorpFig.	16c
Cleveland Graphite Bronze Div., Clevite Corp.	
Crane Packing Co	166
Dixon Corp.	
Excelsior Leather Washer Mfg. Co. Inc.	
Felt Products Mfg. Co., Packing Div.	
Garlock Inc	16a
Gits Bros. Mfg. Co.	
Goshen Rubber Co. Inc.	
Grover Piston Ring Co. Inc	. 18
International Packings Corp Figs. 9a, 10b,	
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Redesigned drive, motor mount give low-maintenance operation

A NEW DRIVE system is one of the more outstanding features on the latest *DoALL* power saws, the Models C-69 and C-70. The drive uses a new concept of motor mounting and redesigned variable-speed drive, cutting head pivot assembly, and spindle assembly.

The original DoALL power saw was the first scissor type machine with enough rigidity and accuracy to use the high-speed saw band developed by our company. The new drive was planned so it could be used on machines already in the field.

In designing the new drive, we gave careful consideration to trouble-free, low-maintenance service. Belt replacement, being one of the principal servicing requirements, was given particular attention.

How it works

We began with the motor and developed a unique mounting that provides positive, constant belt tension. The 5 hp motor is mounted on a chassis that travels on ball bearing ways. The tension spring is long enough so there is less than 2% variation in belt tension throughout the working range. Tension is adjusted by two jam nuts that are easy to get at.

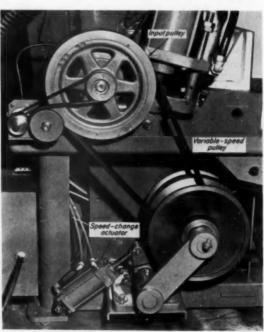
The belts from the motor pulley to the variable-speed idler pulley and to the input spindle pulley have been increased from 1-3/16 in. to 1-7/16 in. wide. Minimum expected life is 2000 hours.

The main shaft of the variable speed drive is larger and is lubricated differently. The sleeve rotates about the shaft on two bronze bearings. The shaft itself is a hollow grease receptacle. A spring-loaded cylinder in either end forces the grease through a hole into the bearing areas. Although recharging is infrequent, it's made easy by a fitting in the outboard end of the shaft.

The end cones are keyed to the sleeve, and the center of the sleeve is superfinished for the speed-change cone. This cone has a bearing which consists of a steel sleeve faced with a fiberglass and teflon bearing surface. The fiberglass provides strength and stability; the teflon provides lubricity.

The new variable-speed drive has a number of other improvements. There are no cantilever shafts; all are supported at both ends. The speed-change actuator is a hydraulic cylinder that acts along the center line of the drive, eliminating any bending or turning moment. The cylinder itself has been enlarged. The drive ratio is 6:1, providing band speeds from 60 to 350 fpm.

Servicing again was considered in designing the stops that limit the high and low speed positions. These are simple jack screws with lock nuts against which a cast iron segment stops at either extreme of travel. The machine frame has added support below the drive.



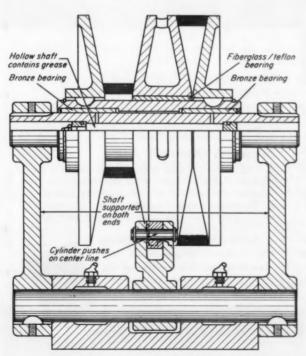
VARIABLE-SPEED pulley is rigidly supported.

By JACK HENDRICKSON, chief engineer, DoALL Co.

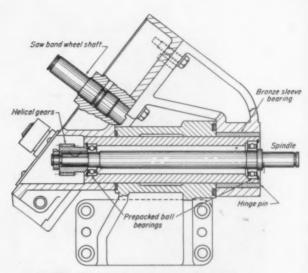
The cutting head swings about a hinge. Power is transmitted from the drive to the cutting head through a shaft at the center of this hinge. To assure that heavy cutting loads will not twist the assembly—which could cause galling—the hinge bracket has been strengthened.

The bearing on the far end of the hinge pin is subjected to the heaviest turning moment. It has been more than doubled in size. It also has been changed from cast iron to a bronze sleeve bearing. Two thrust bearings locate the hinge endwise.

The bearings in the spindle running through the



SPEED-CHANGE cone has fiberglass/teflon bearing.

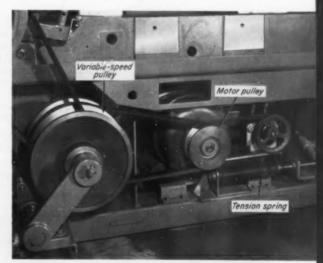


HINGE PIN sleeve bearing was doubled in size.

hinge pin have been changed to prepacked ball bearings that require no additional lubrication. They are mounted so they may be replaced in the field, should this ever be necessary.

We didn't make any changes in the gear transmission between the shaft and the band wheel. This transmission, driven by the input pulley, has two helical gears working at a 52° angle. This unusual angle is necessary so the cutting head can be tilted to clear the work and so the saw band doesn't have to be twisted 90°. The helical gears drive spur gears which drive the saw band wheels.

(For a more complete description of this transmission, see the Sept., 1959 issue of Power Transmission Design, page 23.)



MOTOR MOUNT chassis runs on ball-bearing ways.

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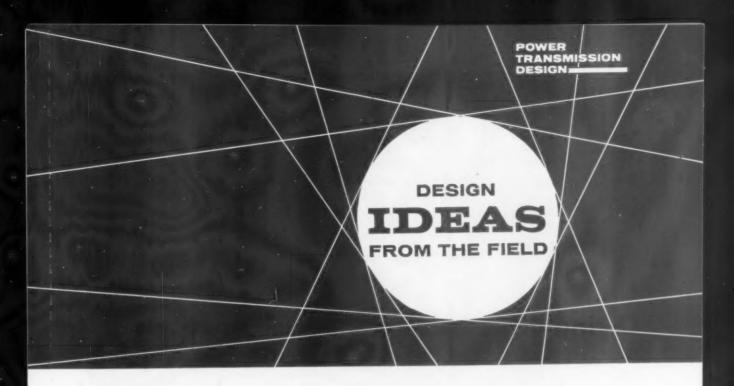




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Power transmission ideas from the . . .

Machine Tool Exposition

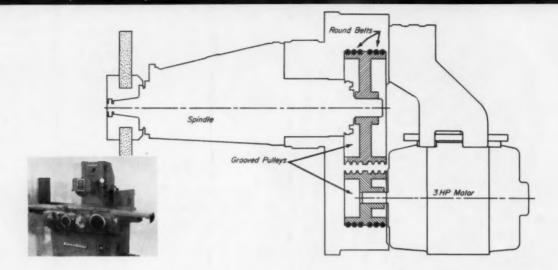
THE IDEAS in this month's *Idea Section* are all derived from power transmission systems of the machine tools to be exhibited at the Machine Tool Exposition in Chicago this month. Naturally, it would be impossible to describe every drive that'll appear there. However, we feel the ones shown in the pages following are representative of the types used in this industry.

If you're planning to attend the show, you'll have a chance to see these ideas in action. To help you find them, we've given the booth number of each manufacturer who contributed to this section.

Incidentally, the Machine Tool Exposition is expected to have the greatest display of metalworking equipment every brought together under one roof. There'll be more than 1000 machines, shown by more than 130 producers. Sponsored by the National Machine Tool Builders' Association, it'll be held at the International Amphitheatre from Sept. 6 to 16.

Almost all the new machines being shown for the first time have some provision for automatic operation. Just as automation was the theme of many of the machine tools introduced at the last exposition, in 1955, the theme this year appears to be numerical control.

And, as it has in the past, the Production Engineering Show will be held concurrently on Chicago's Navy Pier. There'll be a wide array of power transmission equipment, components, and accessories on display there. A preview of these products also is included in this issue, starting on page 50.



O-ring drive transmits power smoothly

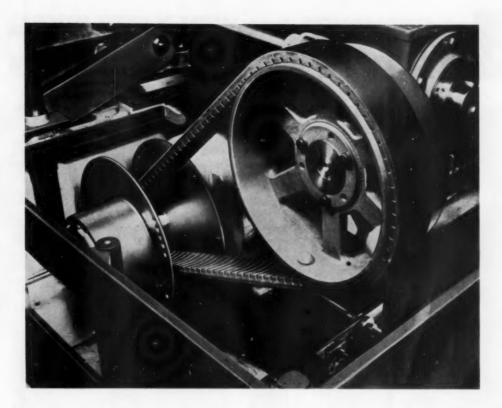
MAKING ITS DEBUT at the Machine Tool Exposition, the 1030 *Micromaster* surface grinding machine has a greater capacity than any present Brown & Sharpe surface grinding machine.

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motor through 6 round belts—which look like large O-rings—running in grooved pulleys. This drive, called the *Oriflex*, is said to give an extremely smooth flow of power.

Brown & Sharpe Mfg. Co., Booth 452.





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A VARIABLE-SPEED drive provides infinitely variable spindle speeds on the *LAN-NU-ROL*, a cylindrical-die thread-rolling machine.

The drive transmission, powered by a 7½ hp motor, is simple and efficient. There are no change gears. Power is transmitted from the motor to the gearbox by a variable-speed belt drive, and speed changes from 166 to 500 rpm are made by an adjusting screw.

The variable-speed pulley is designed to eliminate fretting corrosion as well as freezing and sticking. Bearing surfaces are re-oiled from an oil reservoir with each rotation of the pulley. The continuous rotational pumping action of the flange hub on the sleeve renews and evenly distributes the oil film on the bearing surfaces.

The gearbox consists of two output worm gears driven by an input worm shaft which has two highhelix, double-enveloping worms running in oil. The



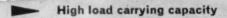
transmission is rated at 94% efficiency at maximum speed and 88% at minimum speed. Horsepower capacity is 18.5 hp at maximum speed and 10.3 at minimum speed.

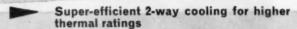
Two propeller shafts, each fitted with automotive type universal joints, transmit torque from the transmission to the inclinable roll spindles. A flanged coupling, located at the rear of the transmission, allows one spindle to be rotated independently of the other to correct any mismatch between the dies.

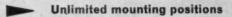
Landis Machine Co., Booth 432.



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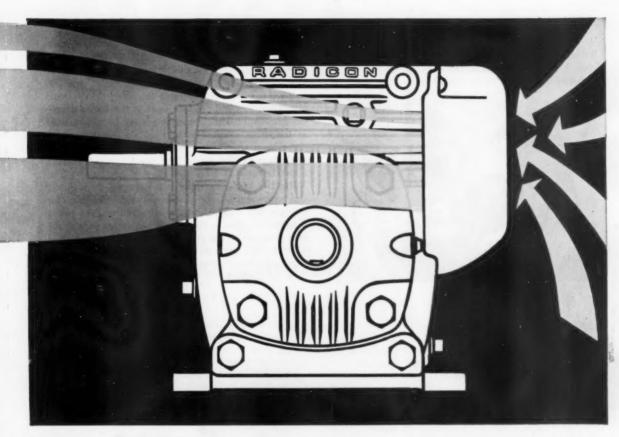








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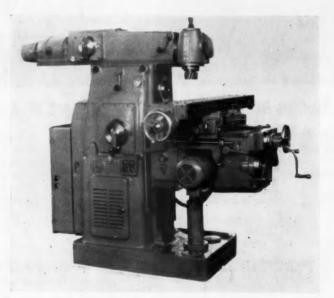
Its high production rate is partly due to the close control of hobbing speed made possible by the variable-speed drive. With this drive, consisting of variable-pitch pulleys, hob speed is adjustable from 200 to 1200 rpm, and the operator can select the optimum hob speed that will produce work at the fastest practical rate. Approximate speeds are set by graduations at the drive control knob. For fine regulation you use a hand tachometer (furnished with the machine) while turning the knob. The constant-speed driving motor is rated at 1 hp.

Rigidity of the machine is maintained throughout; and many extra-large parts are used. Shafting, for example, has high diameter-to-span ratios. Feed power is tapped off close to the main drive, rather than in the area from which the gear blank and hob derive their rotation. This prevents feed-torque error in the timed hob-to-gear-blank relationship.

Barber-Colman Co., Booth 923.

IDEAS

Interlocked controls give motorized ram versatility

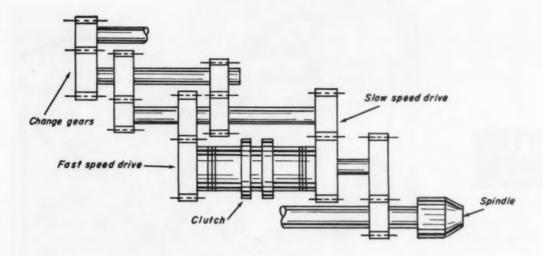


A MOTORIZED RAM that can be adapted to any Kempsmith *Master-Mill* has been developed by this producer of milling machines. The new ram has vertical and/or universal head attachments for angular, multiple-surface, vertical, and horizontal milling.

The motorized ram is driven by a 3 hp motor, with electrical controls at the front and rear of the machine

and an electro-magnetic brake. The electrics are interlocked to motivate the head and machine spindle separately or simultaneously. A dial selector speed change mechanism provides eight changes and ranges of 50 to 2250 rpm. Lubrication is by a pressure oil system.

Kempsmith Machine Co., Booth 347.



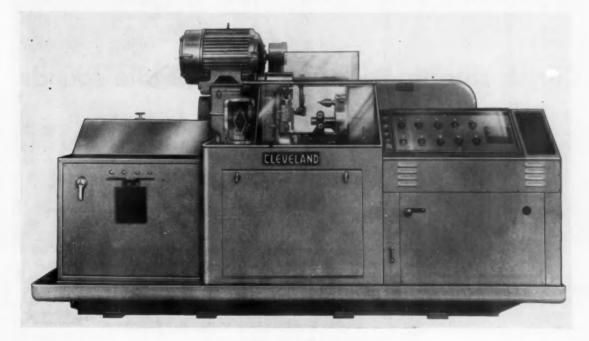
One clutch, one motor give four speeds

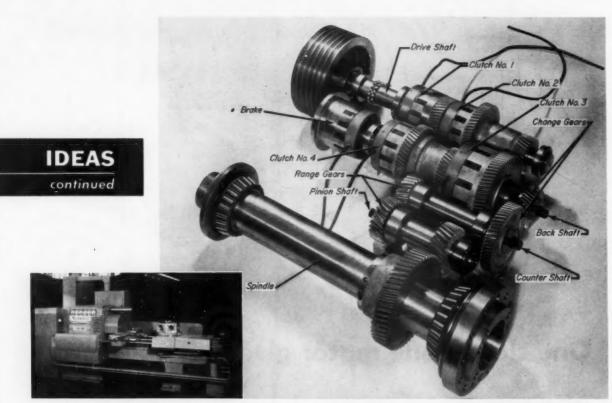
THE SINGLE-SPINDLE *Dialmatic* automatic screw machine has four automatically-changed spindle speeds, both forward and reverse, available for each set of change gears. Pick-off change gears can be changed to get 122 spindle speeds, ranging from 24 to 1820 rpm.

A two-speed motor powers the spindle and provides two speeds. Two more speeds are made available by a disc-type friction clutch. All speed changes are done automatically with pushbutton controls.

An electric feed drive provides separate, infinitelyvariable feeds for all ten turret positions. A feed monitor indicates the exact feed in ipm for each turret position.

Cleveland Automatic Machine Co., Booth 900.





HEADSTOCK GEAR TRAIN works like this to give four speeds: Speed changes are made by engaging the clutches in combinations of 1-3, 2-3, 1-4, or 2-4. With the 1-3 combination, the gear with clutch 1 is driven by the driveshaft, turning the cluster gear free on the second shaft. This drives the cluster gear free on the driveshaft to the clutch 3 gear driving the backshaft. In the

2-3 combination, the smaller gear on the driveshaft cluster gear drives the gear on the second shaft driving clutch 3. With 1-4, the clutch 1 gear drives the larger clutch 4 gear. With 2-4, the large clutch 2 gear drives the smaller clutch 4 gear. A typical 4-speed combination is 121, 222, 356, and 651 rpm. By changing change gear and range gears, 140 speeds are available.

Clutch combinations change spindle speeds

THE HEADSTOCK on the Gisholt Masterline 2F Fastermatic automatic chucking turret lathe has four electric multiple-disc clutches that provide four spindle speeds for each set of change gears.

The helical gears in the constant-mesh headstock are hardened and ground. There are four shafts and a spindle, and power is applied to the driveshaft with a belt drive from a constant-hp 1800 rpm motor. All thrust on the shafts is applied to bearings mounted in the front wall.

The driveshaft has a 6-groove B-section V-belt pulley on the outer end and is mounted in three bearings—two floating and one fixed. One of two clutches mounted on the shaft drives a single gear on a ball bearing; the second drives a cluster gear on two bearings.

The second shaft, or backshaft, has a brake on one end, with the drive cup mounted in the head casting. There's a clutch on the shaft to drive a bearing-mounted cluster gear, another clutch to drive a single bearing-mounted gear. A spline on its extreme end drives one of the change gears.

The third shaft, or countershaft, is splined on either end, one to carry a change gear and the other to carry a range gear. The fourth shaft, or pinion shaft, is splined on one end for a range gear and a pinion gear is mounted between the bearings to drive the spindle.

The spindle is mounted on two precision flange cup taper roller bearings. The headstock is lubricated with a spray system over the gears and bearings.

Gisholt Machine Co., Booth 1042.



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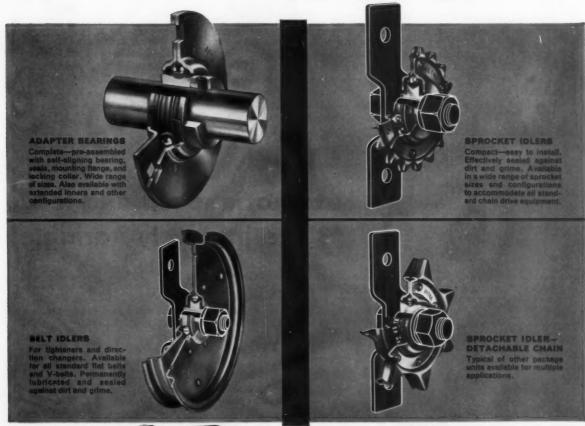
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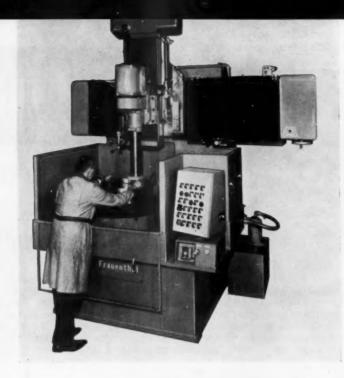


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IDEAS continued

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The feed mechanism also is infinitely variable, taking its power from a dc motor mounted in the drive section of the upper column. It's basically a mechanical design with power transmitted through a worm and worm gear. The feed is engaged by a magnetic clutch, and a dial potentiometer indicates the feed rates. Spindle feeds range from 1 to 7 ipm.

The spindle is carried at the lower end in a pair of preloaded precision sealed ball bearings. A second bearing supports the spindle in the upper end of the spindle quill. The spindle quill has the rack, or feed, teeth cut directly into the sleeve.

Edlund Machinery Co., Booth 531.

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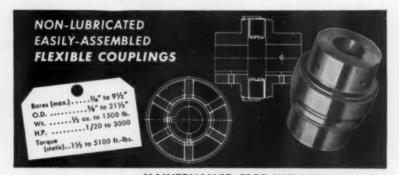
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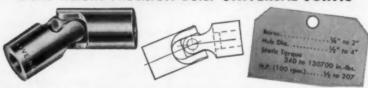


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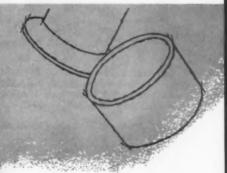
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How to prevent bearing failure

By H. O. WALP, chief metallurgist, SKF Industries, Inc.

Finding the reason for a bearing failure is the first step toward the cure. Sometimes the reason is obvious. On the other hand, a complete laboratory analysis may be necessary to find the cause. This article won't make you an expert, but the information and illustrations will acquaint you with many of the more common causes and their symptoms.

ANTIFRICTION bearings do not wear out even after long service if properly cared for. They may eventually reach their fatigue limit. But most bearing failures occur long before fatiguing of the materials occurs. The flaking which occurs when fatigue limits are reached is illustrated in Fig. 1.

Premature bearing failures occur if bearings are: (1) overloaded; (2) improperly or inadequately lubricated; (3) contaminated; or (4) damaged by careless handling, or installation on shafts or in housings that do not fit properly. Poor fit in housings or on shafts may also cause overload failures. In addition to these primary causes of failure, there are two others—pitting from electric current and damage from vibration of stationary bearings—which will be briefly discussed.

Overloading

The only difference between failures from overload and fatigue is the time it takes. The most obvious cause of overload is selecting the wrong bearing. The cure is easy: Calculate accurately the bearing loads ^{1,2} and use a big enough bearing.

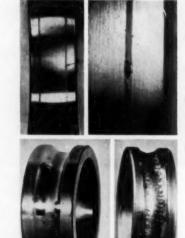


FIGURE 1. Flaking, the result of fatigue, in antifriction bearings is shown here in the early, left, and advanced, right, stages.



FIGURE 5. Corroded rollers from water or some other corrosive agent.

^{**}Determining Bearing Loads Due to Power Transmission," POWER TRANSMISSION DESIGN, May, 1960, pp. 48-52.

²⁴Determining Bearing Loads Due to Power Transmission," POWER TRANSMISSION DESIGN, August 1960, pp. 40-44.

Other causes of overload are undersize housings, oversize shafts, misalignment during mounting, expansion of the inner race by forcing the bearing too far on a tapered shaft or adapter, and excessive preload during adjustment.

Undersize or out-of-round housings will reduce the bearing clearances and load the bearings excessively. Both of these will squeeze the outer race out of shape to produce a localized failure pattern, Fig. 2. The same sort of failure may also be produced by a split housing when the halves are bolted together if the bore is undersize. Out-of-round shafts have the same effect.

With pillow blocks, distortion of the housing bore will produce out of roundness, and the same sort of failure can occur if the mounting surface is not flat and smooth.

If a bearing is not seated squarely in a split housing it can be pinched across the corners of the outer ring when the cap is bolted down. Examine a bearing which failed for this reason and you will see a definitely defined load track on opposite sides of the outer race.

Overloading can also come from misalignment dur-

ing installation. This condition also produces stress on the retainer. This, and poor lubrication are the primary causes of retainer failure. Causes of misalignment are: housing bore not parallel to shaft, shaft shoulder not square with bearing seat, bent shaft, or inner ring cocked on the shaft due to careless installation.

When the housing bore is not parallel with the shaft, the wear path on the outer race will show it by not being parallel to the edge of the race. The other conditions show up in the same way on the inner race.

Misalignment failure can also occur with cartridge bearings if the cartridge is not bolted squarely to the machine frame.

Initial overload can also be caused by binding outer races and excessive thrust in opposed mountings. A design where this could happen is shown in Fig. 3. The excessive thrust load on one bearing is transmitted through the shaft to the other, so both are overloaded.

To avoid overloading ball bearings when mounting them on tapered shafts or adapters, rotate the outer race while the bearing is being forced onto the taper.

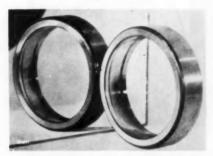


FIGURE 2. Overloading from distortion of a bearing ring is shown by a locallized failure pattern. A mirror here shows how flaking occurred on opposite sides of this ring forced out of round by its housing.



FIGURE 3. This sketch shows how an axial overload can be applied to two bearings when endcover A is tightened down. Force against the outer race that the cover bears against is transmitted through the balls to inner race, shaft, and inner race of the other bearing. Since the outer race of the other bearing is held by the housing, high load results.



FIGURE 4. Wear or lapping caused by dirt in a bearing.



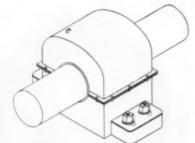


FIGURE 7. Simple shroud or sheet metal box can keep contaminants out of bearings.

FIGURE 6. Corrosion pitting where balls or rollers contact the races and dark brown color show that corrosion happened before the bearing went into service.



FIGURE 8. Discoloration of the bearing steel from overheating. Loss of temper causes early flaking and failure. Lack of lubricant caused this one.

PREVENT BEARING FAILURE continued

When even the slightest amount of binding is felt, the inner race has been expanded as much as it should be. With spherical roller bearings, the decrease in internal clearance as the ring is forced onto the taper should be checked with feeler gages to maintain the recommended value.

Contamination

Dirt in a bearing is any solid substance that doesn't belong there. It may be airborne grit, dust, or dirt; or, it may be metal chips or particles coming from some failed part of the machine in which the bearing is installed.

The large pieces may be pressed into the races and balls and cause dents or scratches. Fine particles act as an abrasive and cause lapping of the bearing parts. This can be seen and felt in the ball or roller paths of self-aligning bearings, Fig. 4. These paths will be polished as will the balls and rollers. If there are no breaks in the surfaces of the balls or rollers and the path is clearly defined, you can be sure that there was

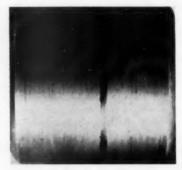
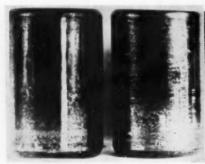
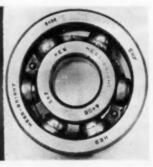


FIGURE 10. Smearing shown on this bearing roller was caused by too thick an oil.







a

FIGURE 9. Sliding, skidding, and smearing are used to describe this condition, a, caused by not enough or the wrong kind of lubricant. Flaking also occurs, b. Eccentric wear of this retainer, c, is the result of poor lubrication.



FIGURE 11. False brinelling, shown here, can be told from ball denting from other causes because false brinelling wears away polishing lines on the races. This condition may also occur with other types of antifriction bearings.





FIGURE 12. Bearings can be damaged by careless treatment. Here are an inner ring cracked by forcing on an oversize shaft and an outer ring cracked by hammering on it.



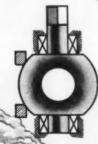
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Cutaway of typical FLO-BALL Valve for liquid oxygen service

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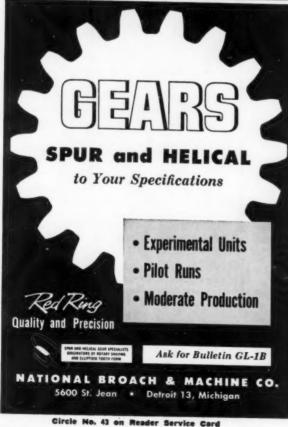
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ORANGE ROLLER BEARINGS







PREVENT BEARING FAILURE continued

fine dirt in the bearing.

Deep-groove bearings are not as easy to examine as others because you can't see the balls and ball paths. A check can be made by feeling the clearance between inner and outer races. To do this lay the bearing on a flat surface and hold one ring stationary. Then, if the other ring can be moved parallel to the flat surface. the bearing is worn. Don't try to feel this wear with the bearing held in your hand. Normal internal clearance can be mistaken for wear, this way.

Another type of dirt which can cause lapping is the iron oxide formed during rusting. This damage is shown in Fig. 5.

When a bearing corrodes before it's put in service, it will, of course, be noisy the first time it starts up. This type of corrosion is characterized by pitting where balls or rollers contact the races, Fig. 6, and dark brown color.

Both dirt and water may get into a bearing with the lubricant. So, lubricant, lubricating devices, and lubricating methods should be closely watched. Seals should also be checked thoroughly and often. In many cases, an inexpensive shroud or sheet metal box, Fig. 7, can be worth more than its weight in gold because it keeps contaminants out of a bearing.

Lubrication

Antifriction bearings don't need much lubricant. But, what they need, they need badly. Not enough or the wrong kind of lubricant is a very common cause of bearing failure. Grease is adequate for lubrication of many bearings. In applications where loads, speeds, or temperatures are high, oil lubrication is necessary.3

Lack of lubricant produces a high-pitched sound and a rapid rise in bearing temperature. If the bearing



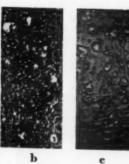


FIGURE 13. Pitting from an electric current can be seen in the roller shown here, a. Magnification is needed to see the craters made by current, b, and burns from arcing, c.

runs this way for long, it may seize, intense overheating may draw the temper of the bearing steel and cause softness and early failure, or cage, balls, rollers, or rings may wear. Fig. 8 shows what can happen. In the early stages, overheating can be recognized by the blue color of the bearing.

Too much or the wrong kind of lubricant can be almost as bad as too little. This will produce an increase in the temperature of the bearing which may damage it. Too thick a grease or oil may also keep the balls or rollers from rolling. They then slide and cause smearing of the parts, Fig. 9, and early failure.

Very rapid starting, combined with heavy loads and low temperatures can also cause smearing. The low temperatures which stiffen or thicken the grease increase the probability of this happening, but it can also happen at normal temperatures. Skidding or smearing can also happen when loads are light if acceleration is rapid. In this case, the inner race skids on the balls or rollers before they have a chance to roll, Fig. 10. In either case, early failure of the bearing results.

Damage

Ball denting or brinelling is usually caused by excessive axial pressure on one race while the other is held, and the bearing is not turning. The most common cause of ball denting is improper installation procedures.⁴ Pressure on the outer race to force the bearing onto a shaft will cause ball denting. Of course, pressing on the inner race to force the bearing into a housing will have the same effect.

Although this is not so common, ball denting can be caused by high load in the radial direction. Another cause is vibration while the bearing is stationary. This is called false brinelling because the loads which produce the dents are not high. False brinelling most commonly occurs when a machine is in transit. It can also happen if the vibration of an operating machine or shaft is transmitted to one that is not running. False brinelling, Fig. 11, can be told from ball denting, despite the similarity, because polishing lines on the race will be worn away by false brinelling.

Other sources of damage are mistreatment, Fig. 12, and electric currents. Passage of electrical current through a bearing will cause pitting of rolling elements and races. The pitting is the result of small arcs which burn away some of the metal. The pits cause noise. Sometimes the pits are large enough to be seen, Fig. 13a. High magnification is needed to see some, Fig. 13b, 13c.

Other causes of bearing failures are undersized shafts or oversized housings. Either of these will allow the mating bearing ring to spin. This causes heat, smearing, and rubbing cracks. All of these may lead to early failure.

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IT'S WATERPROOF. THE PERFECT LUBRICANT FOR ALL CHAIN SIZES. ASSURES LONG, TROUBLE-FREE PERFORMANCE—LOWER MAINTENANCE COSTS. COMBATS RUST AND MOISTURE.

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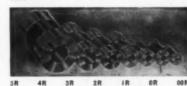
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^aW. J. Schimbke—"Oil vs. Grease," POWER TRANS-MISSION DESIGN, January 1959, pp. 63-65.

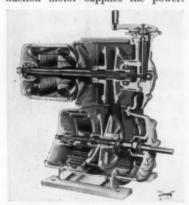
[&]quot;Mount Bearings Carefully—Stop Failures," POWER TRANSMISION DESIGN, April 1960, pp. 40-42.

Production Engineering Show

To get complete information on these products, use the Reader Service Cards bound into this issue.

Adjustable speed drive

Called the Allispede Drive, it provides infinitely adjustable speed over a wide range through the mechanical interaction of adjustable diameter discs and a ribbed belt. An ac induction motor supplies the power.



Speeds as low as 1 rpm and as high as 10,000 rpm are available by a combination of the drive with an integral gearhead. Speed ranges up to 8:1. The drive can be supplied with a drip-proof, totally enclosed or explosion-proof motor or can be modified electrically or mechanically for special requirements. Construction is cast iron.

Louis Allis Co., Milwaukee, Wis., Booths 127, 129

Circle No. 200 on Reader Service Card

Absolute level machinery mount

This mount maintains level within 0.0005 in. per foot of length, regardless of load, with a repeatability of better than 1/10 of 1%. Named the Serva-Levl Mount, it's basically a pneumatic servo-mechanism that senses variations in the load on the



supporting plate and increases or decreases air pressure inside the mount to compensate. A damping orifice in the pneumatic system stops abrupt changes. Units may be operated individually or slaved to a single intelligence source. Operating from a standard air supply, the mount is installed by sliding it under the support points of the equipment. Since the mounted equipment is cushioned on air, it also isolates vibration and shock.

Barry Controls, Inc., Watertown, Mass., Booths 387, 389

Circle No. 201 on Reader Service Card



The new Series M couplings—with nylon gears and steel sleeves—need no lubrication. Equipped with Taper-Lock bushings—each coupling size can accommodate a range of shaft sizes. For instance, the 162M, now available, will take shafts from ½" to 1½" with proper size Taper-Lock bushings, and up to 2" without the bushings. Hubs are machined from bar stock and the one piece sleeve is made of steel. This design means a smaller, light weight coupling that is easier to install and maintain and yet can transmit the necessary power. Size 162, Series M gear couplings can be used for continuous operation up to 5000 rpm at terques up to approximately 2000 inch pounds.

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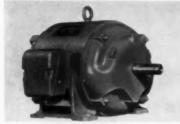
SIEMAG FEINMECHANISCHE WERKE GMBH

Circle No. 53 on Reader Service Card

POWER TRANSMISSION DESIGN

Cooler motors

A line of open drip-proof motors, from 1 to 600 hp are designed for cooler operation by using vents in the terminal box and end bells. In-



ternal deflectors shield the vents against vermin and debris. Other features include pre-loaded ball bearings at both ends, aluminum rotors mounted on steel shafts and electronically balanced, and a terminal box that can be rotated to 4 positions.

Brook Motor Corp., Chicago, Ill., Booths 601, 603

Circle No. 202 on Reader Service Card

Electronic ac load monitor

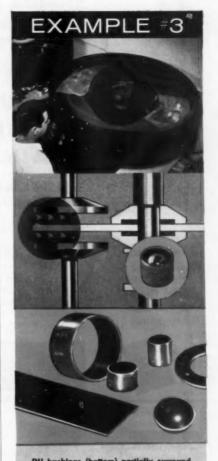
The device monitors motor torque and will respond to actual power demands instead of current demands only. It will detect motor load changes as small as a fraction of 1%. Named TorqueTrol, it uses a phase discriminator to monitor current, voltage and power factor of induction motors. This gives an accurate signal proportional to actual power or load on the motor which in turn controls a heavy duty machine tool relay. A built-in timer can be provided to bypass motor starting, when high power is needed. The timer can also be used to prevent triggering of the output relay on momentary everloads.

Clark Controller Co., Cleveland, Ohio, Booths 137, 139

Circle No. 203 on Reader Service Card

Numerical control system

Control has two sections—data processing and response mechanism. The first section establishes an analogue signal proportional to the machine motion by tape command, decade switch input or punched card. The response mechanism responds in proportion to the analogue signal output of the data processing section. This response section is basically a simple 60 cycle ac closed servo loop having a linear feedback potentiometer, geared to the machine motion. It transmits a feedback signal pro-



DU bushings (bottom) partially surround such steel bull in the new "Reuverol" bull-galaxy principle variable speed drive (center), capable of operating up to 8000 rpm. This permits dramatic advance in centrifuge equipment (top) for more accurate missile and eigeraft component operational G-force testing. Design illustrates use of DU hushings in lubricated ball bearing where dry operational capability pays off in hard-to-lubricate areas.

DU* DRY BEARINGS

Solve Another Problem

"Our 909 Variable-Speed Transmission is a high-torque, ball-disc friction drive† which utilizes two clusters of steel balls for the transfer elements instead of the more conventional single-ball configuration. Many bearing materials were tested before a satisfactory cluster cage assembly was evolved. The successful design in-corporated DU bushings which are partially swaged around each ball for increased bearing area. In addition to an extremely low coefficient of friction, the bushings transfer heat away from critical areas much more efficiently than other materials tested. Problems concerning wear, and tolerance of foreign particles have virtually disappeared."

R. E. Brown

Vice President—Engineering GENISCO, INC.

DU metal is an ideal bearing material for many applications. It withstands much higher velocities, runs much cooler at lower speeds than other unlubricated bearings . . . has a compressive strength of 51,000 p.s.i. DU metal is applied without the need for temperature-limiting adhesives . . . will withstand from $-328^{\circ}F$ to $+536^{\circ}F$.

GARLOCK

Apply DU dry bearings to appliances, automobiles, aircraft, farm and industrial machinery, office equipment. Standard bushings and thrust washers available for ½" to 2" shafts; strip available for special fabrication. Write for engineering catalog DU-458. Special Products Dept., Garlock Inc., P.O. Box 612, Camden 1, New Jersey.

*Trademark, Glacier Metal Company Ltd. †Manufactured under

license agreement from W.S. Rouverol, University of California at Berkely



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Circle No. 19 on Reader Service Card



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- Choice of 4 or 5 Mounting Positions Ratings from \(^1/4\) through 2 H.P. 1:1 or 2:1 Ratio optional

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Circle No. 21 on Reader Service Card

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76 Standard Sizes, for A.S.A. No's 35, 40 and 41 chains, in stock for immediate delivery.

Also hub types, special holes, ring types and others including sprockets to your own "specs" can be furnished quickly in small lots or production runs.

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Write for complete details and representative costs or submit requirements for quotation.

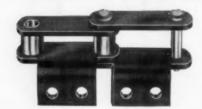
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Circle No. 20 on Reader Service Card

SHOW PRODUCTS continued

portional to position of this motion from a fixed reference point. The motor gear drive actuator is a multispeed system. High speed provides rapid traverse by a motor driving through a conventional gear train. Lower speeds direct the machine motion to final positioning which is obtained by use of a special electromechanical micrometer system. A notable feature is the use of modular units which can be changed by a plant technician.

Diehl Mfg. Co., Somervile, N. J., Booths 136, 138

Circle No. 204 on Reader Service Card

High speed ball bearings

Special and high-precision ball bearings are designed for high speed and critical applications such as machine



tools, are available in many types and sizes. Capacities, tolerances contact angle and retainer designs are intended to meet all bearing problems.

Fafnir Bearing Co., New Britain, Conn., Booth 217

Circle No. 205 on Reader Service Card

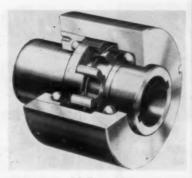
Outdoor motors, submersible motors

A weather protected induction motor drive (to be shown with F-M single stage air compressor, with speed increasing gear) is NEMA II class, rated for 600 hp at 1800 rpm. It's intended for use in completely unprotected outdoor installations. Also on show will be a submersible pump motor for deep well turbine pumps which is water lubricated and designed to "live" in water; and several small polyphase motors with normal radial-air-gap construction suitable for machine tools.

Fairbanks, Morse & Co., Electrical Div., Freeport, Ill., Booths 350, 352 Circle No. 206 on Reader Service Card

Dual torque locking device

Called Rev-Lok, it features two op-



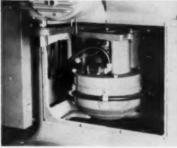
posing sets of full complement sprags which completely block the possibility of reverse torque feedback to the input shaft. It works both clockwise and counter-clockwise to drive, overrun, position and backstop. Other exhibits will include high performance over-running clutches, holdback clutches, high speed backstopping assembly complete with oil reservoir, and a line of all-metal centrifugal clutches.

Formsprag Co., Warren, Mich., Booths 323, 325

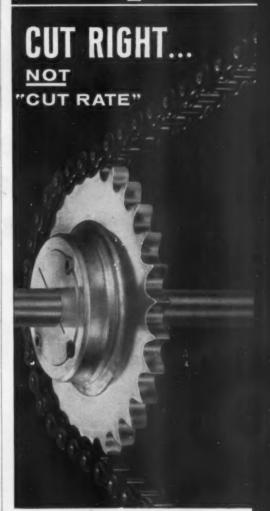
Circle No. 207 on Reader Service Card

Swing-out power assembly

Special design feature of the Vari-Power shown is that it swings out of its installation for inspection and maintenance. Assembly includes high



inertia axial air-gap motor, magnetic clutch brake coupling, and integral clutched shaft for mounting belt pulleys, gears, sprockets etc. It provides variable dwell time, emergency stop, interlock and overload protection for start-stop machinery. A continuously running motor gives a flywheel effect to meet sudden high power demands and to bring the machine to top speed instantly. The clutch-brake provides variable cycle time and emergency stop braking. Clutch can also be regulated by rheostats for overload protection. The Vari-Power line includes motors ranging from 1/3 hp to 3 hp with clutch sizes from 4 in. in diameter Another PLUS value...



Sprockets that are not cut right can cut chain life by as much as 50% to 75%. For smoothest action...for maximum service life of both chain and sprockets, cut-tooth sprockets must be made to precise tolerances. Rex Cut-Tooth Sprockets are made to exact tolerances to fit precisely with the chain for longest life of both chain and sprockets. For more data, mail the coupon.



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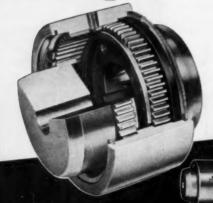
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smaller strong simple



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Sier-Bath has done away with undesirable weight and inertia by eliminating flanges . . . reducing size as much as 40 percent and cutting weight to half that of flanged types. Such savings in size mean considerably lower cost!

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More horsepower can be transmitted through the one-piece sleeve of the Sier-Bath Coupling than through flanges and bolts. Precision made, smaller gear teeth offer better load distribution. No steel castings are used on Sier-Bath couplings!

simpler

There are only seven parts to the Sier-Bath coupling. It can be assembled or dis-assembled in seconds. Sier-Bath Couplings won't "freeze-up" in corrosive service, even after years of use. Simplicity in design means lower cost to you.

Send for Sier-Bath's general Catalog C-5 and Bulletin N-1 on Nyflex Couplings



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FLEXIBLE COUPLING DIVISION 9252 HUDSON BLVD., NORTH BERGEN, N. J.

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Ferguson Machine Corp., St. Louis, Mo., Booths 246, 248

Circle No. 208 on Reader Service Card

Stroboscopic tachometer

A new version of the Strobotac tachometer (Type 1531-A) features a fundamental speed range of 110 to 25,000 rpm. By use of extremely short flashes (1 to 6 microseconds). high-speed motion of rotating and reciprocating machine parts can be "frozen". No mechanical contact is needed with the machine being measured, no power is absorbed, so that the machine's operation is not affected. A specially developed Strobotron lamp produces the high intensity flashes, with peaks of 0.21, 1.2 and 4.2 millioncandlepower for three ranges; high (4000 to 25,000), medium (670 to 4170), and low (110 to 690). Single flash rate peak is 7 millioncandlepower. Speeds of up to 250,000 revolutions per minute can be measured by using flashing rates that are submultiples of the speed to be measured. The entire assembly, packaged in a flip-tilt case, can be carried by a leather neck-strap.

General Radio Co., West Concord, Mass., Booth 609

Circle No. 209 on Reader Service Card

Variable speed transmissions

A new transmission called the Ratio Divider provides infinite adjustment between input and output shaft speeds and maintains the set ratio even though input speeds may vary from zero to maximum. It may be driven from either end. A new type of internal spring loading is used to maintain the ratio in spite of load variation. Also featured will be cutaway transmissions showing a new linear cam control which offers linearity of output speed with crank adjustment, varying air pressure, or electrical signal.

Graham Transmissions, Inc., Menomonee Falls, Wis., Booth 303

Circle No. 210 on Reader Service Card

Needle roller bearings

The Camrol, Cagerol, Guiderol and

Multirol series of needle roller bearings will be on show, offering a complete line to fit all heavy-duty applications. Typical original equipment that uses these lines of bearings will be displayed and also special bearings and their applications.

McGill Mfg. Co., Inc., Valparaiso, Ind., Booth 213

Circle No. 211 on Reader Service Card

Hydraulic hand pump

Designed for use with the new OTC 2 and 4-ton capacity single cylinder rams recently introduced, these compact hydraulic hand pumps develop a full 8,650 psi. Length is 14 5/16



in. with an oil capacity of 13.5 cubic inches. Piston area is .110 square in., diameter is 3/8 in. and stroke 9/16 in., displacing .0621 cubic inches. Hose outlet is tapped 1/4 in. NPT.

Owatonna Tool Co., Owatonna, Minn., Booth 435

Circle No. 212 on Reader Service Card

Tolerance ring

The Star tolerance ring is a corrugated open ring made of hardened steel. It serves as a wedging shim between a shaft and its mating part or to fix any round member in its mating hole without the need of interference fits or keys. Comes in 6 sizes with maximum shaft diameters from .250 to .750 in., bore diameters from .283 to .822 in. and bore depth from .635 to 1.080 in., with wide tolerances due to its elasticity. The ring is a German patent and will be produced under licence.

Roller Bearing Co. of America, West Trenton, N. J., Booth 117

Circle No. 213 on Reader Service Card

Bearings and ball screws

Recirculating anti-friction Tychoway bearings and Super-Cision ball screws will be demonstrated as products for supporting machine components moving in a straight line, and positioning them with a minimum of mechanical force. Used together,

Another PLUS value...



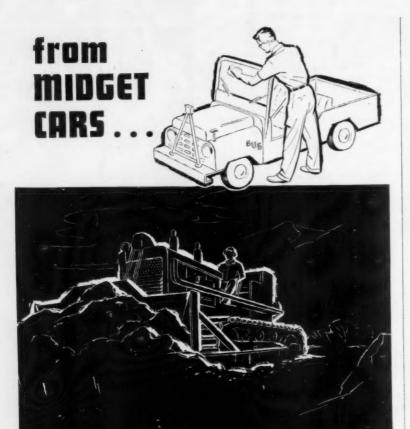
Rex Roller Chains are designed to give you longest possible wear life. For example, as shown above, all standard roller chains have oil holes in the bushings to assure easy penetration of lifeadding lubricant to the important pinbushing contact area...a vital factor, particularly on high-speed drives. You get many more cycles of wear life...a PLUS VALUE premium chain at no extra cost. For complete information, mail the coupon.



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Both are driven by Rockford Spring-Loaded Clutches.

These versatile power-links drive many vehicles of all types and sizes. Torque loads range from 50 to 2,530 ft. lbs.! Sizes vary from the compact 6" clutch to the powerful 16" double plate unit. Positive, full-motion driving

power with smooth starts and controllability is yours with Rockford Clutches. Write today

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Export Sales Borg-Warner International 36 So. Wabash, Chicago, III. SHOW PRODUCTS continued



they help make linear motions accurate and repeatable. The ball screw features a twin nut design that has vernier preload adjustment for eliminating backlash.

Scully-Jones and Co., Chicago, Ill., Booths 229, 231

Circle No. 214 on Reader Service Card

Air/hydraulic brake system

This system uses an industrial hydraulically-applied brake, worked by an air operated hydraulic power cluster that multiplies system air pressure to a much higher hydraulic brake pressure. Designed as a safety



brake for inrunning rolls on rubber mills and calenders, it is set by deenergizing a solenoid air valve by a safety switch. Air pressure is transmitted to the power unit, causing pressure to build up in the hydraulic circuit which applies the brake. The brake control is equipped with pressure sensitive switches which stop the drive motor unless there is sufficient air pressure in the control for a number of fail-safe stops. Brake will also set if electric power is cut-off.

Wagner Electric Corp., St. Louis, Mo..Booth 260

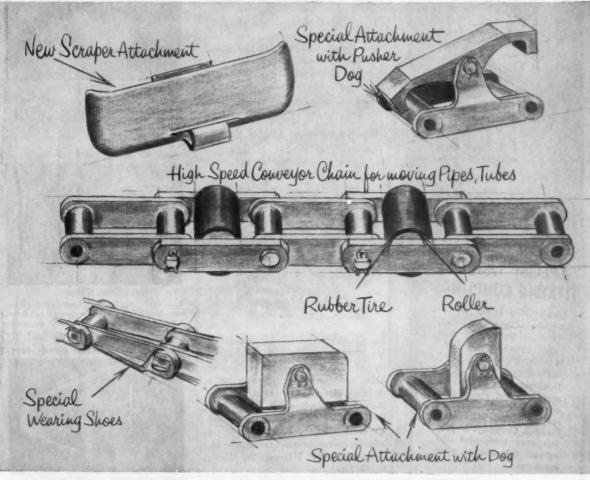
Circle No. 215 on Reader Service Card

AC induction motors

The following lines of motors will be on show: standard horizontal motors from 1/4 to 250 hp; vertical Holloshaft motors from 1 to 1000 hp;

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Moline makes "specials" for OEMs



Take advantage of two new Moline services which can help you solve design problems.

First...send for the new, comprehensive Moline Conveyor Chain Manual and Design Engineer's Handbook which shows all types and sizes of standard chains and lists dozens of attachment combinations with details on application and performance. Everything is included to help you "spark" new ideas for improving and modernizing your equipment.

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Moline Chains

MOLINE MALLEABLE IRON COMPANY
St. Charles, Illinois

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SPECIFY THOMAS FLEXIBLE COUPLINGS

Like a THIEF in the NIGHT an inferior coupling causes wear and damage to your machines—resulting in high maintenance costs and costly shut-downs.

Troublesome maintenance problems and down time are eliminated when you specify Thomas "All-Metal" Flexible Couplings to protect your equipment and extend the life of your machines.

UNDER LOAD and MISALIGNMENT only THOMAS FLEXIBLE COUPLINGS offer all these advantages:

- Freedom from Backlash
- Torsional Rigidity & Free End Float
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 - Original Balance for Life
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 Temperatures

Write for our New Engineering Catalog 60

THOMAS FLEXIBLE COUPLING CO. WARREN, PENNSYLVANIA, U.S.A.

Circle No. 50 on Reader Service Card

SHOW PRODUCTS continued

Synchrogear motors—single, double and triple reduction, from ½ to 75 hp; and Varidrive variable speed motors from ¼ to 75 hp. All these will be exhibited with Uniclosed, totally enclosed and explosion-proof construction. The Shaftmount Synchrogear gear reducer, covering ⅓ to 40 hp, and controlled speed systems using Varidyne and Varitrol will also be shown.

U. S. Electrical Motors, Chicago, Ill., Booths 159, 161

Circle No. 216 on Reader Service Card

Stepless variable speed drives

The new "400 Series" of fractional hp drives features a built-in safety disconnect for the output shaft when load exceeds torque rating; shaft is



reconnected when torque is reduced to correct rating. Other improvements include speed control with positive high and low stops worked by a standard lever; new case housing with larger surface for better heat dissipation and increased porting for air intake. Drives available with or without motor, reverse and gearhead.

Zero-Max Co., Minneapolis, Minn., Booth 250

Circle No. 217 on Reader Service Card

All the preceding products can be seen at the Production Engineering Show, Sept. 6-16, Navy Pier, Chicago. Our regular New Products department starts on page 60. For complete information on any item, continue to use your Reader Service Card.

WOOD'S POWER TRANSMISSION PRODUCT NEWS



NEW, NON-FREEZING VARIABLE

Wood's new "SVS" stationary control, variable speed drive has positive locking collars and other, patented features which eliminate freezing, assure easy speed change. No lubrication is required. Uses standard v-belts and stock companion sheaves. Write for Bulletin 6102.

Circle No. 56 on Reader Service Card



NEW, TREMENDOUS SAVINGS

Wood's new Ultra-V Drives handle up to 3 times more horsepower than conventional v-belt drives in a given space...reduce overall drive dimensions as much as 50%... cut weight up to 25% and costs up to 30%. Write for Bulletin 9102.

Circle No. 57 on Reader Service Card



POSITIVE ACTION-LONG LIFE

Wood's Timing Belt Drives provide positive, slipfree action. Belts are all muscle. No high initial tension, tension devices or lubrication needed. Drives are light weight, compact ... quiet and clean. Wide load and speed range. Equipped with famous Sure-Grip Bushings. Write for Bulletin 2100.

Circle No. 58 on Reader Service Card MP/360B



T. B. WOOD'S SONS COMPANY

CHAMBERSBURG, PENNSYLVANIA
ATLANTA • CAMBRIDGE • CHICAGO
CLEVELAND • DALLAS



Virginia Mills, Swepsonville, N. C. manufacturer of upholstery materials, bought the Sure-Flex Coupling for its readily recognized, vibration-absorption, no-maintenance, no-lubrication features. They didn't count upon one of the "plus features" of this No. 10, \$33 coupling to save them \$1500 and six weeks downtime. It happened like this . . .

A wing nut, used to lock the carrier of yarn into a dye vat, worked loose, passed a strainer and into the dye pump. Damage amounted to \$1500. Six weeks of expensive downtime were required to replace the pump, which was driven by a 75 horsepower motor through a flexible coupling.

Shortly after installing a Sure-Flex Coupling, another

nut passed into a dye pump. The coupling wound up so tightly that the flexible member jumped out of the flanges, disconnecting the pump from the motor. Inspection showed no damage. The pump and the coupling were put back into service, the latter with its original flexible sleeve. Virginia Mills is now standardizing on Sure-Flex Couplings.

This "safety factor" is just one of many bonus features that you get with Sure-Flex Couplings. More important are its 4-way flexing action which absorbs all types and combinations of misalignment, and from 5 to 15 times more shock and vibration than other leading flexible couplings, its lack of wear and its simple, trouble-free design. And the cost is low. Get the complete story.



write for bulletin 5103

T. B. WOOD'S SONS COMPANY . CHAMBERSBURG, PENNSYLVANIA

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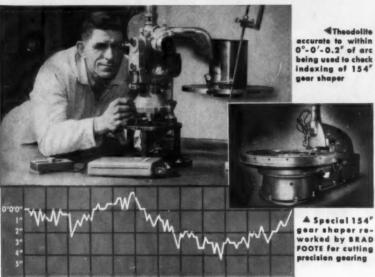
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BRAD FOOTE

FOR A WORLD AT WORK

SUPERIOR TESTING METHODS

give you gears cut to maximum accuracy and precision



A Actual graph of index wheel accuracy readings in seconds of arc at each 3° (rotation) interval

BRAD FOOTE's constant striving for higher quality leaves nothing to chance. Constant checking of all gear-cutting machines assures all aears are cut accurately to the closest possible tolerances.

Here a BRAD FOOTE inspector uses a Theodolite to verify the accuracy of the worm wheel of a large 154" gear shaper. This instrument is capable of readings accurate to within 0°-0'-0.2" of arc between adjacent readings.

It is through such painstaking attention to every detail of manufacture...from blanks to finished precision gears... that BRAD FOOTE maintains a rigid standard of excellence which is recognized throughout industry.

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Your order for BRAD FOOTE Gears will be processed by an experienced organization of gear specialists and produced on the most extensive and versatile facilities available. Maximum performance and your complete satisfaction are assured because no one shares our responsibility.

OTHER SPECIALIZED BRAD FOOTE INSPECTION FACILITIES

FOR TESTING: Involute • Lead • Tooth Spacing • Red Line
Dial Bridge Gage • Metalography Laboratory

Send for new Bulletin #101 Find out what BRAD FOOTE's vo generations of gear building experience can do for YOU. Write today



RAD FOOTE GEAR WORKS, I

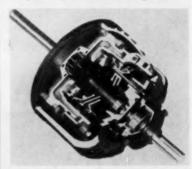
1313 South Cicero Avenue • Cicero 50, Illinois • Bishop 2-1070 • Olympic 2-7700 subsidiary . PITTSBURGH GEAR COMPANY, Neville Island . Pittsburgh 25, Pa., Phone: Spaulding 1-4600

Circle No. 9 on Reader Service Card

NEW PRODUCTS

Controllable fluid coupling

The VariDraulic drive is a controllable hydrostatic fluid coupling. It can be varied in torque and speed to suit the load while the power source is operating at a constant speed. Re-



sult is flexible, shock-free speed control between power and work load. Each coupling is self contained (no external plumbing) and comes in a wide range of sizes, standard packages, or with special shafts, housings or controls to suit specific needs.

Hydraulics Inc., Parsons, Kansas. Circle No. 218 on Reader Service Card

Solid film lubricant

Containing molybdenum disulfide, it's applied by dipping, spraying or brushing and air dries to a hard and durable film on most types of metal surface. Friction coefficient is low over a wide range of pressures, temperatures and surface speeds. Bonding is unaffected by humidity. Can also be used as an anti-rust coating.

Hohman Plating & Mfg., Co., Inc., Dayton, Ohio.

Circle No. 219 on Reader Service Card

Spiral bevel reducers

A line of spiral bevel speed reducers has a right angle shaft arrangement which makes it possible to place the



POWER TRANSMISSION DESIGN



new shaft-rated

DIAMOND ni-Cap

COUPLINGS

give you

- lower cost
- bearing and shaft protection
- quick, easy selection and installation

*Hi-Cap means HIGH CAPACITY

All working parts are heat treated steel, and hardened to provide greater resistance to wear, longer service life.

DIAMOND

Hi-Cap couplings are
available in Finished-Bore
and Taper-Lock to accommodate any shaft diameter
combination from ½" to 6½".

New Hi-Cap Bulletin No. 1060-C
gives construction details, specifications and prices. Warte Today!

DIAMOND CHAIN COMPANY, INC. A Subsidiary of American Steel Foundries

Dept. 718, 402 Kentucky Ave., Indianapolis 7, Indiana Offices and Distributors in Ail Principal Cities

DIAMOND



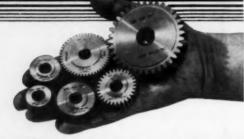
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FUNK UNITS ASSURE SMOOTH POWER SHIFTING

On this Getman Scoot-Crete ore carrier, a FUNK Revers-O-Matic® Drive installation delivers smooth, instant power shifting — forward and reverse — with just one foot pedal. And a FUNK TORQUE CONVERTER automatically adjusts power to speed and load requirements, eliminates wheel spinning.

Just one example of how FUNK MODULAR POWER UNITS may be combined — in an unlimited number of arrangements — without special engineering costs.

Let FUNK help solve your power transmission problem.

FUNK MFG. CO.

Box 577-G, Coffeyville, Kansas

NEW LOW COST STEEL PINTLE CHAIN Locke "600" Series Steel Pintle Chain is designed for industrial and agricultural applications where cost, adverse operating conditions, low maintenance requirements or use with cast sprockets are governing factors. The new chain is produced to exceptionally close dimensions and pitch uniformity from high tensile, heat treated steel. A number of attachment links are available for use in conveyor applications. Low costs result from automatic forming and assembly methods. If your application has cost limitations which prohibit use of roller or malleable pintle chain, write now for information on Locke "600" Series Steel Pintle Chain - available on request in Catalog 60. **CKE** STEEL CHAIN COMPANY 1244 SABINE STREET, HUNTINGTON, INDIANA

PRODUCTS continued

prime mover alongside the driven equipment, freeing more floor space. The efficiency of spiral bevel gears also often makes it possible to reduce the size of motor, controls and other accessories. Energy loss for a single reduction spiral bevel reducer is about 2%, for double reduction 3% and for triple reduction 3%.

Hewitt-Robbins, Inc., Stamford, Conn.

Circle No. 220 on Reader Service Card

Pin type bearing

A double cup bearing has a hollow pin inside the housing which fits in a large counter-sunk hole in the cup OD and prevents the cup from turning in its housing. Designed for ma-



chines where loose cup fits in floating positions are required, the pin type bearing is interchangeable with conventional double cup bearings of the same dimensions. Lubricant is directed to the center of the bearing by using the hollow pin.

Timken Roller Bearing Co., Canton, Ohio.

Circle No. 221 on Reader Service Card

Chain lubricant

Thin-as-water liquid lubricant creeps and travels into spots where ordinary oil will not enter. Exposure to air solidifies it. It protects chain at high and low speeds; resists heat, moisture, shock and corrosion; unaffected by hot water, salt air and extreme temperatures. Trial sample on request.

McGlaughlin Oil Co., Columbus,

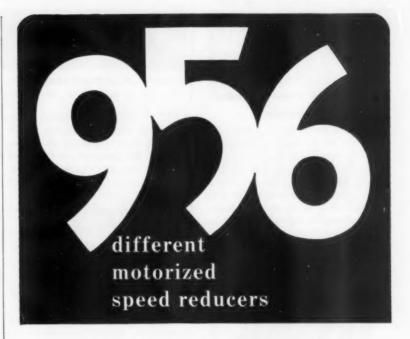
Circle No. 222 on Reader Service Card

Variable speed drive

Drive combines standard variablespeed pulley, belt and adjustable motor base with a standard shaftmounted or horizontal base-mounted Opti-mounted helical geared reducer.







available from stock

Yes! 956 different combinations of Perfection Motorized Worm Gear Speed Reducers are available for immediate delivery, from stock. Ratios range from 5 to 1 to 60 to 1,

in capacities from 1/6 H.P. to 5 H.P. Perfection "C" Flange Reducers may be ordered complete with motor or without motor, to be used with a motor of your own choice.

Flanged motor reducers offer the maximum in compactness, rigidity and adaptability. Through the use of standard NEMA face mounted motors, complete interchangeability between motors is provided. Motor maintenance is possible without disturbing the drive and reducer. Motor assembly is fast and positive with no alignment problems.

Write for your free copy of our new 28 page catalog containing illustrations, charts and tables to help you choose the right Reducer for your particular application. Ask for Bulletin No. M-140.

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AMERICAN STOCK GEAR DIVISION

Circle No. 4 on Reader Service Card

PRODUCTS continued

Driven shaft speeds in various 3:1 infinitely variable speed ranges between 431 and 24 rpm. For use with $\frac{3}{4}$, 1, $\frac{1}{2}$, 2 and 3 hp motors.

Boston Gear Works, Quincy, Mass. Circle No. 223 on Render Service Card

Large sheave bushing

The largest sheave bushing ever produced by the company, it's rated to transmit more than 2 million in. Ib of torque. Made to fit a 42 in. OD pulley, the bushing (Size U) has a 15 in. bore and weighs about 500 lbs. Shown with it is a 1 in. bore bushing (indicated by arrow) that weighs



just under 1 lb. Both bushings are of a quick detachable design for easy replacement.

Fort Worth Steel & Machinery Co., Fort Worth, Texas.

Circle No. 224 on Reader Service Card

Pillow block bearings

The EDX series of narrow width bearings have housings of ductile material, are designed for light and medium duty service. An eccentric



locking collar secures the inner bearing ring to the shaft, and is locked by a set screw. Design features an improved lip-type seal, made of rubber impregnated fabric between metal shields, that remains in positive contact with the inner bearing ring regardless of shaft misalignment. Factory-applied lubricant lasts the life

of the bearing. Available in a wide range of shaft sizes from $\frac{1}{2}$ to $1-\frac{3}{16}$ in. A companion flange type series is also produced.

Hoover Ball and Bearing Co., Ann Arbor, Mich.

Circle No. 225 on Reader Service Card

Tiny precision gearheads

Said to be the industry's smallest servomotor gearhead (right), it



weighs a few grams and measures 3/4 in, long by 1/2 in, in diameter. It can produce step-up or step-down ratios of from 10:1 to 2,025:1, and is machined to closer tolerances than watch gears.

Bowmar Instrument Corp., Fort Wayne, Ind.

Circle No. 226 on Reader Service Card



Mr. W. C. Guenst, Jr. of Master Etching Company, Wyncote, Pa. says:

"General Electric's Polydyne Drive Adds Three Important Sales Features To Our Product" Accurate speed control, wide speed

range and fast speed-changing capabilities mean time savings and better printing plates for users of Master Etching Machine Company's powderless etcher.

These features, along with compact size, low maintenance and operating simplicity, have made Polydyne drives the EXCLUSIVE choice of Master Etching Company for the mechanical adjustable speed drive on their model M-32 etcher.

With Polydyne drives you can get a wide range of process speeds and adapt machine speed to meet requirements of different operations with fewer machines—straight from a-c power.

Why not investigate the advantages of using a Polydyne drive on your equipment? Polydyne

drives are available from ½ to 25 hp with output speeds from 4200 to 5 rpm in a wide variety of configurations and enclosures.

For more information, contact your G-E Apparatus Sales Office or Distributor, or write for Bulletin GEA-6806, Section 854-04, General Electric Co., Schenectady 5, N. Y.

Progress Is Our Most Important Product



Circle No. 62 on Reader Service Card

LITERATURE on drives and components

To get free copies of the following literature, use the Reader Service Cards bound into this issue.

FLEXIBLE COUPLINGS . . . are shaft-rated so that only the diameters of the shafts to be coupled are needed when selecting the correct coupling. Working parts are heat-treated high tensile steel, with a choice of 1155 shaft diameter combinations. Six-page brochure explains construction details and gives complete specifications and prices. Diamond Chain Co., Indianapolis, Ind.

Circle No. 300 on Reader Service Card

MECHANICAL SEALS . . . 8-page Bulletin AD-150 outlines temperature, pressure, shaft speed and other operating information necessary when selecting mechanical sealing devices. Includes 2 tables, one listing sizes and the other detailing construction, of various seals and standard or optional features available. Garlock Inc., Palmyra, N. Y.

Circle No. 301 on Reader Service Card

GRINDING MILL DRIVE . . . called the Twinducer uses two synchronous motors on the mill side of the drive to replace the conventional trunnion drive and reduce drive space by 50%. Electrical load distribution is through an angular rotor shift of one motor. Leaflet 07B9607 has all the details. Allis Chalmers Mfg. Co., Milwaukee,

Circle No. 302 on Reader Service Card

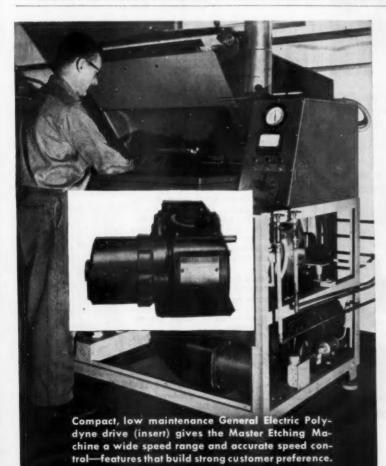
SMALL AC MOTORS . . . are designed for quiet running in fans, appliances etc. Bulletin 445 lists construction features, ratings and dimensions of 32 models which include a choice of 4 frame sizes, 3 types of mounting, 3 pole speeds and 4 types of motor design. Sixteen hp ratings available between 1/100 and 1/3 hp. Robbins & Myers, Inc., Springfield.

Circle No. 303 on Reader Service Card



You have one engine. But it must power TWO work loads . . . one at constant speed . . . one variable. If that's the problem, our VARI-DRAULIC DRIVE may be your answer. It is positively and infinitely variable in torque and speed. Unmatched as a flexible, shock-free speed control between power source and work load. Gears are positive, oil smooth. It has solved the problem for major industries—it may be your solution.





General Electric Offers a Complete Line of Low-speed Drives 1/8 to 200 HP

Select from G.E.'s PLUS LINE of compact mechanical power transmission equipment! A full range of ratings is available many directly from stock.



General Electric Polydyne Drive





Integral-type



Right-angle Shaft Gear Motor



All-motor



Reducer



Shaft-mounted Speed Reducer

General Electric would like to help solve your specialty mechanical power transmission problems.

For further information write:

Mr. C. R. Andersen, Mgr. Product Planning, Gear Motor & Transmission Components Department, 845 E. 25th Street, General Electric Co., Paterson, N. J. Circle No. 63 on Reader Service Card

Member of American Gear Manufacturers' Association





Circle No. 68 on Reader Service Card

WHAT'S YOUR PROBLEM? Is it any of the following? . Diminishing output due to a progressive drop in rpm. Too much down-time because of the need for frequent adjustment due to belt stretch. Excessive maintenance time and expense. Poor belt and bearing life. A drive in an inaccessible or isolated location. A high-ratio short-center drive. MOUNTING THE MOTOR ON AN "AUTOMATIC" BASE MAY PROVE TO BE A SIMPLE AND ECONOMICAL SOLUTION Motor mounting position and direction of pulley rotation are immaterial. Stock Sizes 1/4 to 125 HP. for NEMA frames 56 through 505 and 445-U Larger Sizes for motors up to 500 HP. and for motors having one or two outboard bearings. AUTOMATIC MOTOR BASE CO.

WINDSOR, N.



LITERATURE continued

MINIATURE BALL BEARINGS ...

have an inner ring whose width is increased by 1/64 in. on each side so that spacers and controlled shoulders on shafts can be eliminated. Available in 88 standard types and sizes, with outer diameters from .1250 to .3570, the line includes open radial retainer types as well as flanged and shielded bearings. Data Sheet No. 6007A gives complete dimensional and performance specifications. Miniature Precision Bearings, Inc., Keene, N. H.

Circle No. 304 on Reader Service Card

SERVO ACTUATORS . . . Series 3069 and 3112 for use in aircraft are featured in data sheets 111-10 and 111-13. Description includes engineering data, installation drawing and typical performance curves. *Lear*, *Inc.*, Grand Rapids, Mich.

Circle No. 305 on Reader Service Card

DC CONTACTORS AND RELAYS

pages on contactors and relays for all de industrial control. Includes illustrations, layout and schematic diagrams and specifications. A new design approach permits the customer to reduce inventory by assembling building block components. General Electric Co., Schenectady, N. Y.

Circle No. 306 on Reader Service Card

DIFFERENTIAL REDUCERS . . .

in the new "HM" Series offer a ratio range of 1.1:1 to 50,000:1. Catalog No. HM 60 has 16 pages of engineering data, mounting information, service factors, horsepower, torque and overhung load ratings for the seven horizontal motorized models in this series. Winsmith, Inc., Springville, N. Y.

Circle No. 307 on Reader Service Card

DISC BRAKING EQUIPMENT . . .

for a wide variety of industrial uses is the subject of 10-page facilities brochure. Reviews the principles and advantages of the disc brake system and illustrates many applications. A back-cover pocket contains data sheets for requesting information on braking problems. Goodyear Tire & Rubber Co., Aviation Products Div., Akron, Ohio.

Circle No. 308 on Reader Service Card

FREE DISCHARGE VALVES . . .

including a new low head fabricated steel plate model, are highlighted in Bulletin 02B9206 which has 16 pages on power valves, turbine bypass, drainage and flood control types. Allis-Chalmers Mfg. Co. Milwaukee.

Circle No. 309 on Reader Service Card

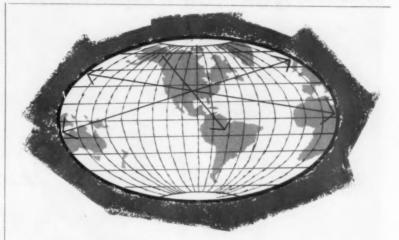
GEAR HONING . . . newest developments and a new machine are described and illustrated in 4-page brochure. Discusses machine operating details and a four-way honing feature. Specifications for both auto-

matic and semi-automatic machines. National Broach & Machine Co., Detroit, Mich.

Circle No. 310 on Reader Service Card

FLEXIBLE COUPLING . . . consists of 2 flanges of heat-treated aluminum alloy with steel drive pins molded in which are joined together by a laminated fabric and synthetic rubber disc. Four page bulletin covers dimensions, rating capacity and selection procedure. Van Gelder Mfg., Inc., Oakland, Calif.

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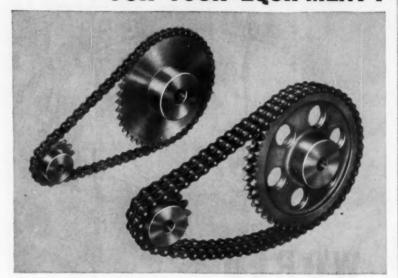
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POWER APLENTY

There's a Tulsa Winch for all applications and they are always available through our international sales-service distributorships. Tulsa Winches are known around the globe for their extra quality, economy, and operating efficiency. Next time, buy Tulsa Winches — the best winch buy.

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TULSA 20, OKLAHOMA
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DO YOU HAVE THE PROPER CHAIN SELECTION FOR YOUR EQUIPMENT?



If there is a question in your mind about the correct size of chain to use for your particular installation, save time and money by consulting ACME Engineers at once. They will assist you in selecting the proper chain drive. In many instances, this depends on how much horsepower you want to transmit . . . the speed and size of your shaft . . . space limitations . . . hours of continuous operations, etc.

These are problems on which our engineers can draw from their many years experience to give you the correct answers.

Consult your nearest ACME Distributor or write our Engineering Department for the answer to your CHAINING PROBLEMS.



Write Dept. 28-N for new 100-page illustrated technical catalog including new engineering section showing 36 methods at chain adjustment.



COMPLETE LINE OF ROLLER CHAINS AND SPROCKETS . DOUBLE PITCH CONVEYOR CHAINS . STAINLESS STEEL CHAINS . CABLE CHAINS . FLEXIBLE COUPLINGS . STANDARD AND SPECIAL ATTACHMENTS

Circle No. 1 on Reader Service Card

LITERATURE continued

NEW PACKAGED BEARINGS ...

are said to combine the advantages of sleeve and ball bearings. Principal design feature is a reservoir of self-wicking lubricant which creates a hydrodynamic oil film between the inner race and the bushing. Four-page brochure, illustrated with 12 charts and diagrams, gives working characteristics and tells how to compute life at various speeds and temperatures. Tann Bearing Co., Detroit, Mich.

Circle No. 312 on Reader Service Card

PLASTIC STOCK SHAPES . . .

and molded and fabricated parts are the subject of 16-page catalog AD-177. Includes units made from Teflon, C.T.F.E., Delrin, Nylon and other resins. Outlines facilities for research and development in molding, extruding and machining. *Garlock Inc.*, Palmyra, N. Y.

Circle No. 313 on Reader Service Sard

RESILIENT MOUNTINGS . . . and products for the control of vibration shock and noise are covered in 8-page Bulletin No. 905. Details general design, performance data and applications for 22 product series. Lord Mfg. Co., Erie, Pa.

Circle No. 314 on Reader Service Card

ADJUSTABLE SPEED DRIVES .

use modular design for greater flexibility. Bulletin SI-351-460 describes Series 35, Size 1 for drives up to 1/3 hp; Bulletin SL-352-560 covers Series 35, Size 2 for drives to 3/4 hp. Both contain complete specifications, construction details and operating information, with sketches of system variations. Cleveland Machine Controls, Inc., Cleveland, Ohio.

Circle No. 315 on Reader Service Card

DRAFTING TEMPLATES . . . for tracing standard right-angle gear drives into new product designs are available free. There's one template for each power rating in the 1/3, 1, and 2-1/4 hp models and separate plan and end views for the 5 hp rating. Ratings are shown in full, half and quarter sizes for scaling to blueprints. Write to: S. Banaski, Marketing Dept., Airborne Accessories Corp., 1414 Chestnut Ave., Hillsde 5, N. J.



This high capacity V-Belt Drive handles 60% more power in 30% less space!

Higher Capacity of Gates Super HC V-Belt Drives solves complex product-development problem!

In developing a larger crusher, requiring more horsepower, Iowa Manufacturing Company was faced with the problem of transmitting 400 hp from a higher-speed engine in a space that had been just enough for conventional V-belts carrying 250 hp.

At the higher speeds, centrifugal force made it impossible to go to larger sheave diameters to accommodate larger belt sections. A wider span of belts was ruled out by Highway Department requirements, which restricted overall machine width to eight feet.

Iowa Manufacturing's designers solved their primary problem of transmitting 60% more horsepower with new Gates Super HC V-Belts.

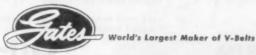
Because Super HC V-Belts have smaller cross section, use narrower and lighter-weight sheaves, pack higher hp capacity in a smaller 'package' than conventional V-belts, designers also succeeded in reducing drive weight, width and height - a decided bonus in equipment that must be moved frequently both on and off the highway.

Nation-Wide Engineering Service

Your nearby Gates Representative can show you how to reduce drive weight, space and cost with Super HC V-Belt Drives. With Super HC, sheave diameters can be reduced 30% to 50%, drive space up to 50%, and drive weight 20% or even more.

Ask your Gates Representative for your free copy of "The Modern Way to Design Multiple V-Belt Drives." or write to The Gates Rubber Company Sales Division, Inc., Denver, Colorado.

The Gates Rubber Company, Denver, Colorado Gates Rubber of Canada Ltd., Brantford, Ontario





Gates Super (HO)



MANY FAST'S HAVE BEEN **WORKING LONGER THAN YOU**

It's a fact. There are plenty of cases where Fast's Couplings have been in service 20 to 40 years. And some of our more enthusiastic engineers say a Fast's should last forever if it's properly applied, installed and lubricated. Whatever opinion you accept, you can bet Fast's Couplings will give you the same smooth-running, lowmaintenance, long-lived performance that makes them the choice of more equipment manufacturers than any other gear-type coupling.

For example, Fast's Coupling No. 1347, shipped in July, 1922, is still in service-and the customer is just ordering his first spare coupling 38 years later. KOPPERS COMPANY, INC., 909 Scott Street, Baltimore 3, Md.



AST'S COUPLINGS

Engineered Products Sold with Service



LITERATURE continued

VARIABLE SPEED TRANSMIS-SION . . . uses the variable pitch pulley principle for stepless speed changes up to an 8:1 ratio. An adjusting wheel changes pitch diameters by changing the belt tension. Spec sheet gives details. Teeco Transmission Co., Beaverton, Oregon.

Circle No. 316 on Reader Service Card

CUPMOUNTS . . . protect equipment against shock and vibration and ensure smoother performance. Bulletin 59-04-10 gives dimensions, load ratings and construction details for the Series 4000. Barry Controls Inc., Watertown, Mass.

Circle No. 317 on Reader Service Card

FLUID POWER EQUIPMENT . .

is used to solve varied engineering problems described in Fluid Power News No. 13. Applications include seagoing dredger winches, paper machine drives, packaging machines, and the rudder controls on a giant ore carrier. Oilgear Co., Milwaukee, Wis.

Circle No. 318 on Reader Service Card



Now Outdates Wood Block and Variable Speed V-Belts

MVS Belt replaces enclosed drive belts without disassembly. Its patented design sets a new standard in V-to-V drives because it is adjustable and is installed in minutes instead of hours. Uniform thickness and width guarantee constant power delivery with no cross-sectional distortion. Available in 26 widths from 11/2" thru 5".

Write Today For Complete Information



MANHEI MANUFACTURING & BELTING COMPANY Manheim 9, Penna.

OM M & B Co 1958

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Here's the low-cost answer to chain breakdowns caused by link-wear, stretch, corrosion and friction. OIL-RITE Chain Oilers feed oil by gravity through solenoid and sight feed valve to brush which rides the chain. Solenoid starts and stops with driving motor, making operation automatic, oiling only when chain moves. Drop feeding adjustable. 9 oz. — 1 gal. in capacity with brushes to suit your chains.

GIVE YOUR PLANT ALL THESE BENEFITS!

- Safe, sure chain subrication
- Reduce chain wear
- Eliminate costly hand oiling
- Cleaner, less hazardous floors

Many styles of Electro and Manual Chain Oilers available. Write for Free Bulletin.

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Oil Cups • Dispensers • Oiling Systems • Valves • Oil Gages • Chain Oilers

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POWER TRANSMISSION DESIGN

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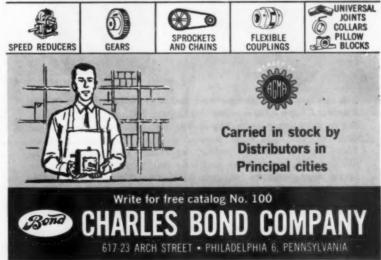


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For Power Transmission Equipment—Power transmission users and designers know Charles Bond as the best and most dependable source of stock power transmission equipment. Bond's almost three quarters of a century of experience in manufacturing power transmission equipment has made it routine to specify Bond products for a great number of applications.

Bond's large factory and distributor stock provide an ideal "instant" source for new and replacement power transmission equipment.

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start on page 50	circle no.
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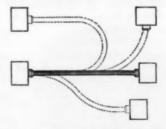
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Save money . . . save time with Johnson standard stock bearings. They make sense. Get in touch with your Johnson distributor today for fast service.

See how much can be saved on a typical special order by using Johnson Bronze Standard Stock Bearings

	10 Rearing	s %6 x 3%2 x 1		
Operations Required	Special Bearings	Johnson GP Boarings		
Rough Bore	Yes	No		
Finish Broach	Yes	No		
Rough O.D.	Yes	No		
Semi-Finish O.D.	Yes	No		
Cut Length	Yes	No		
Chamfer O.D., I.D. on two ends	Yes	No		
Grind	Yes	No		
Stamp	Yes	No		
Total Cost	\$26.40	\$9.20		
Delivery Date	?	Immediately		



Johnson Bronze Company

New Castle, Pa.

West Coast Plant: Oakland 8, Calif.

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GENERAL PURPOSE over 900 sizes



UNIVERSAL BRONZE BARS over 400 sizes



POWDER METALLURGY over 400 sizes



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